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Conservation and Commerce of Cacti and Other Succulents

Edited by
Douglas Fuller and Sarah Fitzgerald

TRAFFIC (U.S.A.)
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Conservation and Commerce of Cacti and Other Succulents

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WASHINGTON, D.C.

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Cover photo: Aloe pillansii, a very rare and protected aloe, is found only in an extremely arid region of northwestern South Africa. Within the last decade, a collector reportedly removed all samples of this species that were of a movable size. (Photo by Linda R. McMahan)

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Foreword

On the island of Madagascar, roadside peddlers tempt passing tourists to buy brightly flowering stalks of Pachypodium, offering specimens "priced to sell" and sized to fit under the seat on the flight home. Halfway around the world, unscrupulous collectors routinely scour the Mexican countryside in search of ever rarer and more wonderfully shaped barrel cacti, knowing that their prickly wares will bring handsome profits in Brownsville or Los Angeles, and even heftier sums in Tokyo or Munich. Just across the border, a full-time posse of "cactus cops," employed by the state of Arizona, works long and dusty hours to protect dwindling stocks of organ pipe cactus and other native desert species from shovel-toting thieves.

Overharvesting for commercial trade is the single greatest threat to many of the world's rare and endangered cacti and numerous other exotic succulents. The trade is notoriously difficult to control, largely due to complex market routes, widely varied national trade policies, and the lack of priority traditionally given by governments to plant protection.

By documenting key trade patterns and problems around the world, Conservation and Commerce of Cacti and Other Succulents, edited by Douglas Fuller and Sarah Fitzgerald, provides an essential reference for those involved in the international struggle to protect threatened plants. Individual authors recommend concrete ways in which to improve controls at all levels, from self-policing actions by nursery owners to changes in international trade law. I hope the ideas presented here will spark debate and, ultimately, constructive dialogue between conservationists and those who profit most from the trade.

William K. Reilly
President
World Wildlife Fund

Preface

The impetus for this book arose in 1981 with publication of the first in-depth report on the international plant trade based on Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and U.S. Customs trade records. The International Trade in Plants by Gibson, McCarten, Campbell, and McMahan focused primarily on three plant groups: cycads, succulents, and orchids. While this report provided a comprehensive view of world trade patterns, it also highlighted the need for greater study of each group. TRAFFIC(U.S.A.), the wildlife trade monitoring program of World Wildlife Fund, undertook to complete these studies, and published the first of these volumes in 1984, Cycads: Status, Trade, Exploitation and Protection, 1977-1982 by Sheryl Gilbert.

Linda McMahan, author of the first chapter of this volume and former Director of TRAFFIC(U.S.A.), initiated the succulent trade project and identified the topics of greatest interest and concern. She realized the need to research trade in the major consumer nations (the U.S., Japan, and Western European countries) and analyze the effects of plant commerce in regions where succulent species are native (North and South America, southern and eastern Africa). An important component of such an analysis is a review of plant discovery, introduction to cultivation, and development of artificial propagation.

As work commenced on these topics, it became clear that the emphasis in the available literature and in trade statistics was on the Cactaceae, a large and diverse family native to the Americas. Readers interested in conservation and commerce of other families with commercially valuable succulents — namely the Aizoaceae, Crassulaceae, and Fouquieraceae -- may be disappointed by this heavy emphasis on cacti. Ideally, another volume devoted to conservation and commerce of non-cactaceous succulents should be developed.

Because of this emphasis on cacti, we chose the title Conservation and Commerce of Cacti and Other Succulents. This volume aims to meet the current need for an in-depth analysis of international succulent plant trade data. It also describes in detail the key succulent plant conservation issues facing decisionmakers in the United States and other countries.

In chapter one, McMahan outlines the history of the world trade in cacti and succulents and lays the groundwork for subsequent chapters that examine recent CITES trade data. In chapter two, Robert DeFilipps' discussion of man's traditional interest in members of the Euphorbiaceae provides a similar backdrop for analyses of the succulent trade.

In chapter three, Sara Oldfield presents the results of her 1985 survey of the Western European cactus and succulent trade. Ranging from southern France to

Denmark and the United Kingdom, Oldfield's investigation addresses the volume and trade patterns of wild and propagated cacti and other succulents. Her report assesses the effectiveness of CITES, EEC regulations, and national laws controlling trade. Oldfield recommends methods to improve enforcement tactics and nursery trade practices.

From TRAFFIC(Japan), Tom Milliken, Kazuko Yokoi, and Shinobu Matsumura provide a comprehensive picture of the troublesome Japanese cactus market in chapter four. Japan remains one of the world's major importers of wild-collected cacti, including many CITES Appendix I species. The authors not only evaluate CITES trade data for the country but present results of their own field investigations into the attitudes and selling practices of Japanese cactus dealers. The authors highlight critical trade problems and recommend increased enforcement and inclusion of more cactus taxa on CITES Appendix I.

Presenting further insight into the international cactus and succulent market, Katharine McCarthy summarizes U.S. CITES trade data for succulent plant genera in chapter five. Using recent trade records — 1980 through 1984 -- McCarthy describes trends in imports, exports, and trade documentation for CITES-listed succulents. She also analyzes U.S. trade in rare species within commonly-traded families, such as the Liliaceae and Cactaceae.

Chapter six and seven focus on cactus trade issues facing U.S. cactus nursery dealers, collectors, and other cactophiles. In chapter six, TRAFFIC(U.S.A.) biologist Douglas Fuller examines the nursery trade in wild-collected and propagated species in the American Southwest and northern Mexico. Presenting the results of his 1984 field investigation, Fuller describes the trade from a conservation perspective, noting both laudable propagation techniques carried out by certain nurseries and harmful collection practices perpetuated by others.

In chapter seven, Gary Lyons, an experienced landscape gardener, describes the impact of the landscape business on native U.S. cacti and other succulents. Using examples from his own experience with botanical garden design, Lyons identifies numerous obstacles to successful transplantation of field-collected cacti. Lyons also notes the damage caused by field collection from a conservation standpoint. He concludes with recommendations to promote artificial propagation of succulent species prized in landscape gardening.

In the concluding chapter, Faith Campbell examines the politics of international plant conservation, particularly the creation and adoption of CITES. Campbell traces the progress of cactus conservation efforts within the scope of CITES and the U.S. Endangered Species Act and evaluates both the strengths and weaknesses of these controls. Campbell proposes a series of measures to improve existing succulent plant conservation programs.

Although we have not standardized the nomenclature for species, relying instead on taxonomic preferences expressed by individual authors, we hope the information presented in Conservation and Commerce of Cacti and Other Succulents will be of use to botanists, law enforcement officials, nurseryowners, and those who work with CITES around the world. In addition, we hope this will be an informative source for horticulturists, collectors, and succulent enthusiasts in general. We welcome readers' comments on all topics and data covered. Most importantly, we encourage readers to evaluate the recommendations presented by individual authors and to share the information with those unfamiliar with the complexities of cactus and other succulent conservation.

Over the course of preparing this volume, we have relied on assistance from many people. We wish to thank the following individuals for helping to make this book a reality: E. U. Curtis Bohlen, Townsend Feehan, Kathryn Fuller, Fannie Mae Keller, Robert McCoy, Linda McMahan, Michelle Mitchell, Christina Ruiz-Esparza, Leonora Sheeline, Janet Walters, and the rest of the TRAFFIC(U.S.A.)/World Wildlife Fund/Conservation Foundation staff. We would especially like to thank Lynne Hardie and Ginette Hemley for their careful review of the manuscript and helpful suggestions during the final phases of this project.

Douglas Fuller
Sarah Fitzgerald

A Brief History of the Cactus and Succulent Trade

Linda R. McMahan*

"[Interest in cacti] has always depended on the trends of the times."
-Wilhelm Barthlott (1979).

From ancient Rome to the present day, succulents, including cacti, have been part of our lives. The Romans knew about some succulent plants, such as the European genus Sedum, commonly called stonecrops. Doubtless they knew of others, such as another European genus Sempervivum. Aloe barbadensis, a succulent of the lily family with medicinal properties, has been in use so long that the original habitats of the species are no longer known (Rowley, 1978). In recent times, our fascination with the bizarre forms, stark beauty, and durability of succulents and cacti increased demand for them to the point where many species became extinct or greatly reduced in their native habitats. Lately, however, new propagation trends, protection laws, and international controls have created hope for their survival in the wild. This chapter chronicles some of the events in the history of the cactus and succulent trade.

Succulent Plant Discoveries: Pre-Nineteenth Century

It was not until the "Age of the Explorers" in the fifteenth and sixteenth centuries that cacti and other succulents became popular horticultural plants. According to one writer, "Europeans first became aware of the cactus family following Christopher Columbus' discovery of America" (Barthlott, 1979). It is probable that Columbus first observed cacti in the West Indies, reportedly a species of Melocactus commonly known as Turk's cap cactus. He collected some to return to Queen Isabella (Barthlott, 1979) of Spain. Melocactus species went on to become one of the very popular cacti grown in sixteenth century England (Castle, 1884). Among Linnaeus' descriptions in his 1753 Species Plantarum were twenty-two species of cacti (Barthlott, 1979) and the succulent genus Euphorbia (Gibson, et al., 1981). In 1774, Frances Masson and Carl Peter Thunberg (one of Linnaeus' pupils) discovered many succulents on an expedition to Africa, including Aloe dichotoma, 70 Mesembryanthemum species, and 40 Stapelia species (Coats, 1969). That same year, cultivation practices for succulents made a great stride with establishment of the first "rockery" or rock garden in England (Fisher, 1982), and rock gardens became frequent sites for cultivated succulents. Rock gardens have continued to grow in popularity up through the present day (Fischer, 1982; Cabot, 1984).

* Dr. McMahan is a Senior Program Officer at the Center for Plant Conservation, 125 The Arborway, Jamaica Plain, MA 02130; she is also a former Director of TRAFFIC(U.S.A.).

Nineteenth Century Europe

The nineteenth century saw phenomenal growth in cactus collecting as a hobby, particularly in Europe. Cacti came into scientific collections in France from pre-established private collections (Barthlott, 1979). Cephalocereus senilis, the old man cactus, was botanically described in 1824 but prior to that large numbers were imported to Europe from their native Mexico (Barthlott, 1979). The 1890 World Fair in Paris exhibited several specimens of old man cacti described as "meters high" (Barthlott, 1979). In 1884, one writer noted the steadily increasing demand for all cacti, and particularly the new trend for miniature cacti that were much more affordable than the larger specimens (Castle, 1884).

The numbers of cactus species cultivated in England grew rapidly after their discovery. The earliest recorded cultivation of cacti in England occurred in 1596, when Gerard's Catalog of Plants mentioned the "ficus indicus cactus," now known as Opuntia ficus-indica (Castle, 1884). Castle noted that by 1796, 29 species were cultivated. By 1819 the number had grown to 45; by 1826 it was 94; by 1828 to 183; and by 1840, 400 species were in cultivation. The number continued to increase to 670 by 1850 and to about 1,000 by Castle's time in 1884. In 1890, the German Cactus Society formed, leading to a new wave of interest in succulents in Germany (Barthlott, 1979).

Some rare or bizarre cacti also made their appearance in cultivation in the nineteenth century. In approximately 1830, Baron Wilhelm von Kawensky found Ariocarpus kotschoubeyanus in Mexico, describing the plant as having "a striking resemblance to a piece of broken rock." In 1832, he sold one of the three plants in his possession for 1,000 francs, more than the plant's weight in gold (Barthlott, 1979).

The first Pelecyphora aselliformis plants reached Europe in the early 1800s but, unfortunately, they died. The fruits, however, yielded viable seeds. In 1884 Castle noted that the species was still "very scarce" in cultivation.

Early Twentieth Century

In the twentieth century, continued interest in trade led to increasing concern about the effects of collecting on wild cactus and succulent populations. In the 1930s, many books and journals reported uneasiness about the loss of succulents in their native habitats (Rowley, 1978). In general, the twentieth century is marked by increased restrictions on trade in wild cacti and other succulents in virtually all source countries, and the evolution of international trade controls. At the same time, the horticultural industry learned new propagation techniques that it applied to large-scale propagation of cacti and other succulents to meet the demand created by the general public and the specialist collector.

The Advent of Cactus and Succulent Publications and the Growth of the Collecting Hobby

In 1929, Desert Plant Life emerged as one of the first U.S. publications about cacti and other succulents. The early issues of this journal give a fascinating glimpse of conservation views of the time, including articles for and against controls on trade in cacti and other succulents that sound similiar to those written today.

The first issue of Desert Plant Life contains several articles on conservation. One of these decries the "fast disappearing native flora of Southern California" and the early efforts of five California counties to regulate removal of wild plants such as Joshua trees, yuccas, and cacti (Anon. 1929a).

Five issues later, a reader who described himself as a collector, stated that cactus-collecting controls are analogous to prohibition of alcohol, and that "so-called conservation" only makes the collector's appetite more expensive and his attempt to satisfy it more dangerous. The writer went on to state, "The desert is large. There is enough plant life there to stock all the gardens in Christendom" (Anon., 1929b).

In a 1930 issue, a reader who sent in a plea to control wild collecting stated, "I almost pray that this cactus craze will exhaust itself" (Hutchinson, 1930). Another reader, who was also a dealer, wrote that he intended to rid himself of all cacti in his stock because "living things cannot endure against the greed of man." He added, "In the Fall of 1925 I put out [my] list of cacti and succulents... Little did I dream then that traffic in native cacti would attain such proportion" (Beecroft, 1930).

In the journal's first few years, articles chronicled efforts around the world to protect cacti and succulents in their native countries. In 1929, the journal reprinted an article from South African Gardening and Country Life decrying the loss of natural areas in South Africa (Anon., 1929c). In the following three years, the journal reported on other laws and issues as they arose, including a new Mexican law regulating trade in 16 cactus genera and prohibiting trade in 26 taxa* (Anon., 1930); a proposed law to protect plants on California public land (Anon., 1931); the new threat to Arizona cacti and succulents created by trade restrictions in California causing commercial dealers to switch collection sites

* These included Ariocarpus fissuratus, A. kotschoubeyanus, Astrophytum asterias, A. myriostigma, Cephalocereus senilis, Cereus gemmatus, Echinocactus flavispinus, E. grusonii, E. helophorus, E. ornatus, E. recurvis, E. saussierii, E. scherii, E. trollieti, E. turbiniformis, Echinocereus delaetii, Mammillaria applanata, M. bocasana, M. carnea, M. elephantidens, M. nivea, M. rhodantha, M. wildiana, Obregonia denegrii, Pelecyphora aselliformis, and P. pectinata (as listed).

(Schilling, 1932); the governor of Arizona's announcement of a new law to control cactus trade (Anon., 1932); an amendment to that law (Anon., 1933); and a plea in South Africa to grow native plants from seeds rather than collecting them from the wild (Anon., 1934a).

In 1934, the journal described Mexico's newest regulations on collecting, as well as that country's collection fees, and published a newly-issued list of species for which collecting was prohibited (Lowry, 1934).* In 1934, Desert Plant Life reported a new South African law prohibiting sale of many plants, including all Lithops and five species of Euphorbia (Anon., 1934b).

By the mid-1930s, however, the emphasis of the journal shifted to the hobby aspects of collecting. Six years after it began, the journal became just one more place to learn about cacti and other succulents; nearly every issue was filled with articles on particular taxa from all over the world and advertisements selling both propagated and wild cacti. None of the remaining issues that I looked at (through 1952) focused on conservation or protective laws. The change in Desert Plant Life may have reflected the concurrent astounding growth in the number of hobbyists specializing in succulents.

Other journals arose to meet the increasing consumer appetites for cactus and succulent information, including The Cactus and Succulent Society Journal, which began in 1928, Succulenta in 1931, and the Succulent Journal of Great Britain in 1938.

Contributions to these journals evidenced the growing popularity of the plants. In one journal, a former stamp collector compared his two interests stating, "Yes sir, a stamp collection is a cold lifeless thing in spite of all the care and fondling it may get, while plant culture is alive, responds to care and is, in the last analysis, a true study of nature" (Bright, 1934). Another writer extolled the virtues of propagation and conservation of natural areas, noting that finer plants could be produced from propagation than could be gathered in the wild (Skinner, 1934).

Many modern books on cacti and other succulents written for the hobbyist favor conservation efforts such as propagation. For example, Lamb and Lamb (1974)

* The 36 taxa included Ariocarpus fissuratus, A. kotschoubeyanus, A. retusus, A. trigonus, Astrophytum capricornus, A. myriostigma, Cephalocereus senilis, Echinocactus (Thelocactus) bicolor-tricolor, E. (T.) bicolor-bolansis, E. (Neolloydia) beguinii, E. grusonii, E. (T.) heterochromus, E. horizonthalonius, E. conglomeratus, E. delaeti, E. pectinatus, E. rigidissimus, Solisia pectinata, Leuchtenbergia principis, Lophophora williamsii, Neomammillaria candida, N. difficilis (chinoocephala), N. difficilis, N. elegans, N. grahamii, N. lenta, N. leona, N. micromeris, N. parkinsonii, N. rhodantha, N. valida (Coryphantha poselgeriana), Obregonia denegri, Grusonia bradtiana, Pachycereus chrysomallus, Opuntia microdasys, and Pelecyphora aselliformis (as listed).

note that despite protective laws, many areas of the southwestern U.S. have been stripped of cacti, at least partially due to overcollecting. They encourage propagation as does Rowley (1978) in his Illustrated Encyclopedia of Succulents. Rowley states that propagation of rare and endangered species is a top priority for the conservation-minded. Glass and Foster (1977) also support propagation.

The number of commercial propagators also grew rapidly to meet the increasing popular demand for plants. As evidence of the rise in new professional interest in cactus growing, advertisements appeared in journals offering cacti and succulents from around the world, many of them raised from seed.

For many people, what began as a casual interest in cacti and succulents became a lifetime hobby. Ginns (1963) stated that he had been fascinated by succulents since the 1930s and while he lost much of his collection during World War II, he was able to rebuild it because of the great abundance of plants available from nurseries or from people who collect plants from the wild. Ginns also compared succulent collecting to stamp collecting, observing, "The very large number of different species...appeals to the collecting instinct....The acquisition of a rare specimen gives the hardened collector...as big a thrill as a philatelist...with a new stamp."

Emergence of the Trade Threat

Despite propagation efforts, the trade in cacti and other succulents took its toll. After the 1920s many writers reported species extinction and the absence of collectable plants from roadside areas. Starting in the 1970s, newspapers and magazines around the country reported continued illegal collecting from the deserts of the southwestern U.S., an activity often referred to as "cactus rustling." Rowley (1978) reported that in both 1968 and 1974, he visited the type locality of the tiny cactus Mammillaria louisae only to find fewer than a dozen plants where at one time many grew; he found collecting of this species particularly pointless since the species grows readily from seed. Rowley (1978) also reported the extinction of Aloe variegata (partridge aloe) because of overcollection.

Collecting threats caused many succulent enthusiasts to think more carefully about conservation. In 1973, the International Organization for Succulent Plant Studies (IOS) turned its attention to preservation and passed a stringent code of conduct for its members in the hope of educating and informing collectors about the consequences of collection (Rowley, 1978).

Cactus and Succulent Trade Since CITES

Signed in 1973, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) regulates trade in many plants and animals, including all cacti and some succulents. Commercial trade in wild specimens of plants appearing on CITES Appendix I is prohibited. As of 1986, 40 cacti and 13 succulent species were listed on Appendix I. For wild specimens of

species listed on Appendix II, commercial trade is allowed only if the country of export or reexport issues a special permit or certificate.

Beginning in 1977, trade data became available in sufficient quantity to undertake the first detailed analysis of the cactus and succulent trade. A government report (McMahan, 1981) estimated that the U.S. imported and exported approximately 10 million cacti and succulents per year in the late 1970s. This estimate contrasted sharply with the official CITES records, which recorded only about 950,000 cactus imports and about 30,000 cactus exports (not counting other succulents). U.S. Department of Agriculture reported U.S. imports of about 5.5 million cacti and other succulents in both 1978 and 1979 (McMahan, 1981).

From 1977 through 1979, a very high number of recorded U.S. imports were of rare species from Mexico, many of which are now listed on Appendix I.* According to Gibson, et al. (1981), many Appendix II cacti and other succulents traded during this time were field-collected: an estimated one million field-collected succulents were imported in 1979. At the same time, a lively trade in Appendix II propagated specimens had been taking place for many years, particularly from Japan and the Netherlands (Gibson, et al., 1981).

Early CITES data were plagued by problems of poor reporting and documentation (Campbell, 1983a), and continued reports of illegal trade in wild plants (McMahan, 1984). Much of the world trade in cacti from Mexico was probably of wild origin** despite increased efforts to regulate the trade (Fuller, 1985a; 1985c). Many species of rare and slow-growing plants like Ariocarpus (living rock cacti) were traded in large numbers from Mexico to the U.S., and often reexported to Japan (McMahan, 1985b; Campbell, 1983b). From 1979 to 1983, imports of Ariocarpus species were about 97,000 and reexports were about 47,000 annually. New regulatory responses attempted to address these and other problems (Anon., 1985) and increased propagation efforts may finally be helping (Fuller, 1985b; McMahan 1985a). McCarten (1985) reports a decrease in wild trade overall, attributing it to economic recession, increased energy costs, and higher shipping costs. Similiar trends towards propagation have been seen in Europe (Oldfield, 1985).

The limited information available on cactus and succulent trade suggests a steady increase in world trade since the plants' discovery by European explorers. In the twentieth century, conservationists, increasingly concerned about trade in wild specimens, brought about international agreements and new laws to regulate the trade. Meanwhile, new propagation efforts have made both rare and common taxa available to the cactus hobbyist and houseplant grower alike. As these efforts

* 1977-1979 imports and exports included 6,666 Turbinicarpus pseudopectinatus; 506 T. lophophoroides; 482 Aztekium ritteri; 2,689 Ariocarpus agavoides; 1,196 A. trigonus; 1,588 Pelecyphora aselliformis; 1,304 Pelecyphora strobiliformis.

**Including in 1982, 7,339 Ariocarpus retusus, 2,000 A. trigonus, 4,800 Turbinicarpus pseudopectinatus, and 4,640 Thelocactus bicolor.

continue, conservationists can judge their effect on the wild populations currently in jeopardy.

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Topics in the Succulent Plant Trade: Euphorbias

R. A. DeFilipps*

Introduction

The family Euphorbiaceae comprises some very well-known plants such as the Christmas poinsettia, the crown-of-thorns, the slipper flower (Pedilanthus), and several other tropical ornamentals (Steffey, 1984; Taloumis, 1984) as well as desirable temperate garden species (Turner, 1983). Aside from these most popular ornamentals, the genus Euphorbia contains numerous other species prized for their ornamental, medicinal, and structural properties. These desirable properties caused collectors to over-exploit many species of Euphorbia, although other factors such as grazing threaten many species. The recognition of these threats led to the listing of all succulent euphorbia species on CITES Appendix II in 1975. This chapter gives a brief history of succulent Euphorbia use and examines the decline of these amazing plants in Madagascar and southern Africa.

History of Medicinal Uses

The family Euphorbiaceae is usually referred to as the "spurge" family. Spurge is a longstanding convenience name that continues in usage because the type genus Euphorbia has a milky sap (latex) in its tissue system and this sap acts medicinally as a purge -- if ingested, the sap is often violently purgative, or cathartic. "Spurge" and "purge" are basically the same word in this context (Rowley, 1984). In many instances, exposure to the sap is also harmful to human skin.

Leon Croizat's interesting book, De Euphorbio Antiquorum Atque Officinarum (1934), is devoted to untangling the confusion of species names for the Indian, Moroccan, and Canary Island euphorbias whose medicinal latex was traded at least as long ago as 1570 in the form of dried resin (gum euphorbium). The resin was sold in apothecary shops of Antwerp, Amsterdam, and London under the name "euphorbium officinarum." The Euphorbia antiquorum L. found on the Malabar Coast of India and in Ceylon (Sri Lanka) may in all likelihood have been introduced there from north Africa very early on. This species represents the "euphorbium of the ancients" (euphorbium antiquorum), which the classical Roman scholar Pliny (A.D. 23-79) named for Euphorbos, physician to Juba, King of Mauritania. (Mauritania included what is now Morocco.) The commercial trade in latex out of Rabat (Sale), Agadir, and the Canary Islands sometimes oversupplied the market, so great was the demand for the gum. As early as 1798, gum-producing species of the Canary Islands, probably E. canariensis and E. handiensis, were also being used for fuelwood or firewood on Fuerteventura Island. The tides of war in non-British parts of north Africa caused

* Dr. DeFilipps is a Museum Specialist with the Plant Conservation Unit, Department of Botany, National Museum of Natural History, Smithsonian Institution Washington, D.C. 20560.

periodic unavailability of the latexes to London and, variously, France and Spain. Still, Leon Croizat is able to give us this simple quotation from Robert Morison in 1699, "Happy is Africa which can export for money the dried latex of these plants."

The utility of Euphorbia species in today's traditional health delivery systems in the Third World is discussed by Mitich (1984) and in UNESCO's Medicinal Plants of the Arid Zones (1960).

Industrial Uses

Arborescent euphorbias such as E. tirucalli are utilized as living fenceposts in various parts of the world such as southern Africa and the state of Pernambuco in northeastern Brazil (Fourie, 1985). Their employment for this purpose has been summarized and illustrated by Aubert de la Rue (1968). Howard and Touw (1982) describe the use of xerophytic cacti for defensive barricades on the West Indian islands of St. Kitts, St. Thomas, Guadeloupe, and Martinique during the period of colonial struggles, and their paper is a useful adjunct to Aubert de la Rue's study of succulent plants as protective barriers. Known as the "pencil tree," the Euphorbia tirucalli ranges from Africa to India and is almost a pantropical introduction. It is not thorny but grows densely and has latex poisonous to skin contact. In 1983, Henderson gave the following prognosis for increased local use of euphorbias as guard plants in southern Africa:

> The succulent Euphorbias have great potential as security barrier plants. Some species very closely resemble the 'ideal' framework species, being sturdy, drought resistant, armed with spines and having a milky latex which is toxic. In some species the latex is so toxic that it would serve as an immediate deterrent to any intruder. There is no other plant or group of plants either indigenous or exotic in South Africa that combines such formidable features. Disadvantages are that they are not fire-resistant, that they are difficult to handle and that they are slow-growing. The latter disadvantage can be offset in some species by planting them as well-grown truncheons.

Euphorbia tirucalli and its candelabra-shaped cousin E. ingens were experimentally tapped in Natal, South Africa during World War II for the very low amounts of precious rubber in their latex. At the same time, the United States was trying to extract commercial grade rubber from the desert shrub guayale (Parthenium, Compositae) in reaction to the unavailability of Southeast Asian rubber from plantations newly-administered by the Japanese. The changing fortunes of war allowed for abandonment of further research and experimentation on new potential rubber sources (Dyer, 1948).

The true rubber of commerce, Hevea brasiliensis of South America, is a member of Euphorbiaceae as is the tirucalli rubber plant, but the house plant known as "rubber plant" is actually Ficus elastica, a strangling fig of the family Moraceae.

Species Pairs

The weedy subgenera of Euphorbia native to the north temperate zone are quite different from the succulent species prized in trade. The stem-succulent African euphorbias have evolved a body-form that is remarkably adapted to survival in the arid environment; these adaptations result in an appearance often very similar to the cactus family that inhabits New World deserts. This phenomenon of similiarity between euphorbias and cacti is known as convergence, heterogenetic homeomorphosis (Szafer, 1975), or parallel evolution. As noted by White, et al. (1941), "It would appear that water storage and heat resistance in plants present problems in the geometry of succulence, which the euphorbias have worked out in ways closely paralleled by the Cacti." There are a number of striking "species pairs" comprising African euphorb and Mexican cactus that are superficially alike, for example, the subglobose Euphorbia meloformis and bishop's cap cactus Astrophytum myriostigma (Trager, 1985); the candelabra-tree Euphorbia candelabrum and the candelabra-cactus Lemaireocereus weberi; the baseball plant Euphorbia obesa and the sand dollar cactus Astrophytum asterias; and the very rare subglobose fish-scale euphorb, E. piscidermis of Ethiopia (Gilbert, 1979), which is nearly identical to the cactus Encephalocarpus strobiliformis. However, any close inspection that reveals the presence of milky sap, cyathium flower arrangement, and non-areolate spines borne on a spine-shield (podarium) will unmask the true euphorb. Several other intriguing xerophytic species-pairs are listed in Appendix A of this paper.

Collection and Exploitation of Madagascan and African Succulents

Few succulent plants were well-enough known to be transported from North America to Europe as early as the Sixteenth Century. Thomas Hariot, who sailed with Sir Francis Drake from the Roanoke, Virginia settlement to England, recorded the American cactus Opuntia humifusa and the textile plant known as "silk grass," Agave virginica, as introduced to England by the year 1588 (Ewan, 1968). Several of the early euphorb introductions to England were Euphorbia antiquorum from India in 1688; E. tirucalli from Africa in 1690; E. canariensis from Spain's Canary Islands in 1697; and E. clava from the Cape Province of Africa in 1700 (Higgins, 1956). D. O. Wijnands (1983) has done a great service by recording the dates of introduction of various succulents into the Hortus Medicus (medicinal plant gardens) of Amsterdam, The Netherlands around the year 1700. Due to the importance of such data -- plant introductions are the first steps of commerce in species for whatever purpose — a number of his determinations are repeated here as Appendix B.

The euphorbias of Madagascar are among the most interesting of all succulent plant groups. The large euphorbias of southwestern Madagascar belong to the taxonomic Section Tirucalli (of which the type species is the E. tirucalli). On that island, the euphorbias constitute a unique plant formation with the xerophytic Didiereaceae (Rauh, 1975, 1983a, 1985). These species tower above the

more commonly known Madagascan endemic E. milii, the crown-of-thorns shrub. By combined reference to the comprehensive monographs of Madagascar vegetation produced by Rauh (1973, 1985) and Koechlin, et al. (1974), one becomes impressed by the role of euphorbias as various co-dominants in this "Euphorbia-Didiereaceae Bush" vegetation. The southwestern Madagascar xerophytic flora has a high percentage of endemism to the island, including 48 percent of the genera and 95 percent of the species. In this region the Didiereaceae comprise four genera: Alluaudia, Didierea, Decaryia, and Alluaudiopsis. The dominant tree-euphorbias sharing this semi-arid thorny woodland zone, which bounds the coast from Fort Dauphin southwards past Cap St. Marie and northwest all the way to Morondava (see Koechlin, et al., 1974; map, p. 298) are: E. stenoclada, E. plagiantha, E. enterophora, E. oncoclada, and the possibly introduced exotic, E. tirucalli. This region is also rich in species of succulent-xerophytic Aloe (Liliaceae), Kalanchoe (Crassulaceae), the pachycaul (squat, thick-stemmed), Pachypodium (Apocynaceae), and the larger pachycaul Adansonia (Bombacaceae) (Rauh, 1977-1978).

To some extent, the Euphorbia-Didiereaceae Bush as a phytogeographic unit, has been undermined by the forces of human enterprise in Madagascar. Destruction and disturbance prevail due to inroads made by sisal plantations (sisal is used for fiber), zebu cattle grazing grounds, invasive Opuntia cactus species, and the growing of sorghum, peanuts, and sweet potatoes (Rauh, 1973; Koechlin, et al., 1974). The Euphorbia-Didiereaceae vegetation in its more or less natural, undegraded condition covers about 2,643,000 hectares (including other dry types of woodlands to the periphery of the Euphorbia Bush). Threats to the species-rich and highly diverse habitats on Madagascar have been graphically depicted by Alison Jolly (1980) and Jean-Louis Guillaumet (1984). The government of Madagascar, the World Wildlife Fund, and other international leaders in environmental conservation have jointly resolved to help improve the conservation efforts in the country.

The trade status of plants of southwestern Madagascar has been summarized briefly by Rauh (in litt.) as follows:

> At the moment lots of Madagascarian plants, as Pachypodium species, Didiereaceae, Euphorbiaceae and others (all protected species) are exported with permission of the government. Most of the species cannot be artificially propagated, neither by cuttings nor by seeds. They are all wild collected plants, as Pachypodium brevicaule for example. It is not possible to propagate it by cuttings or seeds, for it grows too slowly.

Succulent collection in southern Africa has a rich and varied history. It is difficult to imagine the privations endured by botanical collectors who penetrated past the coastal Cape Floral Kingdom of South Africa into the interior, where many of the succulent euphorbias occur. The collectors, some of whom were paid professionals, disillusioned missionaries, or soldiers marking time between tribal disturbances, are described by Kimberley (1982), Herre (1971), Reynolds (1974),

Lighton (1973), and Gunn and Codd (1981). Major plant collectors of South Africa included William Paterson in 1777-1780, William Burchell in 1801-1815, C. P. Thunberg in 1772-1774, Carl Zeyher in 1829-1843, as well as Pierre Sonnerat who disintegrated three pairs of fragile French shoes climbing Table Mountain; Emil Holub who survived attack by the Mashukulumbe tribe in Barotseland to exhibit his vast collections in Vienna and Prague; Georg Krebs (1792-1844), naturalist to the King of Prussia, whose last consignment of specimens included a Bushman barreled in brine for the Berlin Natural History Museum, and who is commemorated by the lovely orange-red species of "treasure flower" Gazania krebsiana (Compositae); and the Swede Johann Wahlberg, commemorated by Euphorbia wahlbergii, who was trampled to death by an elephant in 1856 (a fate shared by Euphorbia collector Eugenio Ruspoli in the Horn of Africa's Gobo region in 1893).

Bulbous plants such as the amaryllid Buphane and the liliaceous Urginea from the Cape of Good Hope were advertised for sale as early as 1612 by Emanuel Sweet, a Dutch nurseryman who had a plant stand at the Frankfurt Fair that year and issued a catalogue entitled Florilegium. Gunn and Codd (1981) note that Sweet would sometimes destroy surplus stocks of rare bulbs in order to keep the prices high — an interesting economic precedent. In 1633, not long after Sweet's Florilegium appeared, Giovanni Ferrari's De Florum Cultura Libri IV was published in Rome. It included drawings of South African Amaryllis, Brunsvigia, Haemanthus, and Ferraria, and it also depicted the Goddess Flora cursing her thieving gardeners and changing them into slugs and beetles for punishment. Among early representations of South African Euphorbias were the E. caput-medusae and E. clava illustrated in Johannes Burman's Rariorum Africanarum Plantarum, Amsterdam, 1738. As knowledge of euphorbs grew they were demarcated further into, for example, the "cucumber -", "caterpillar-", and "melon-ribbed" euphorbias in a 1795 travel book by Francois Le Vaillant.

There are some 700 known species of succulent euphorb but of these only a comparative few, the smaller subglobose ones, are most desired as indoor plants in the U.S. and Europe. The subglobose euphorbias are (Mitich, 1983):

1. E. meloformis Aiton (1789). Range: Uitenhage, Port Elizabeth, and Albany Districts of the Cape Province, South Africa.
2. E. obesa Hook. fil. (1903). Range: Graaf Reinet District of the Cape Province, South Africa.
3. E. symmetrica White, Dyer & Sloane (1941). Range: Willowmore and Beaufort West Districts of the Cape Province, South Africa.
4. E. valida N.E. Brown (1915). Range: Jansenville and Somerset Divisions, Albany District of Cape Province, South Africa. This is not recognized as a valid species by Gordon Rowley (1975).
5. E. turbiniformis Chiovenda (1936). Range: Mijertein Province of western Somalia; rediscovered by J.J. Lavranos at Eil airstrip, Somalia in 1969 (Horwood, 1976); and collected by Ruspoli and Riva in 1893 in the Ogaden region, Ethiopia.
6. E. piscidermis Gilbert (discovered 1971). Range: West of Deghabur in the Ogaden region between Ethiopia and Somalia.

Also from Somalia is said to be the rarest Euphorbia of all, E. columnaris; only a few of these 4-foot tall plants are left in the wild (Trager, 1983). In addition to E. columnaris, northern Somalia supports the endangered, if not already extinct, E. cameronii, whose showy white bracts lend it potential for horticulture (Lucas and Synge, 1978). Somalia and adjacent countries have recently yielded many euphorb novelties (Carter, 1977, 1982; Bally and Carter, 1976).

E. meloformis was originally introduced to England from the Cape in 1774, and it received praise of the kind usually reserved for orchids due to its singular shape, as evidenced by the following excerpt from London nurseryman George Loddiges' Botanical Cabinet of 1820:

> This plant may be considered one more of the wonderful works of God. It is so original in its form, and so diverse from all others, that it seems made to strike the beholders with astonishment. Ah, would that such things might sometimes help to lead the mind to the contemplation of their divine Author, whose creative hand has formed such endless variety, and allotted each a place suitable to its nature.

We know that E. meloformis had reached Japan by 1871, for it is illustrated in a Tokyo exhibition catalogue of that year (Rowley, 1982). This comparatively late date indicates that the exhibition of (then) rare subglobose succulents was not too far behind that of cacti. In fact, Rowley (1982) noted that, "In 1867 a cactus show was held in Tokyo — perhaps the earliest on record, since I can trace no earlier date in Europe or America."

Another subglobose species to receive a great amount of early attention was E. obesa (currently listed in IUCN's Vulnerable category), published in 1903 by Sir Joseph Dalton Hooker (1817-1911), who had been Director of the Royal Botanic Gardens, at Kew in 1865-1885. It is an almost spherical plant when young, becoming elongated as shown (in color) on the cover of the September-October 1977 issue of Cactus and Succulent Journal (U.S.). These unisexual spheroids are known as "baseball plant" and "basketball plant," and even have apparently stitched seams (ribs) like a ball. E. obesa has been described by Walther Haage (1963) as morphologically, "...the acme of succulence, exposing as it does the minimal surface area in relation to volume." It is furthermore, according to Barkhuizen (1978), "...very definitely the most sought after species (of Euphorbia) by succculent collectors."

So coveted was the specimen upon which Sir Joseph based his original description and illustration of E. obesa that it soon "disappeared" from the Kew Collection, and Hooker (1903) was moved to state that "Possibly its illustration in

this Magazine may lead to the discovery of its whereabouts." Twenty years elapsed before a living specimen of it was again seen at Kew.

As White, et al. (1941) indicate, E. obesa is only known in nature from the type locality on low stony hills near Kendrew in the Graaf Reinet District in South Africa, where some of the colonies were pillaged by collectors for several years and were eaten by groups of foraging baboons. The plants we see in shops today are most likely seed grown. The female plants produce capsules enclosing grey, 2 mm wide seeds, which readily germinate using directions provided by Tobusch (1947). However, seeds are apparently still rather difficult to obtain in most places since the breeder must bring together or have on hand, both a flowering female and flowering male plant for pollination and fertilization, and the plants do not reproduce by vegetative methods (Subik, 1971).

G. A. Frick's article in the first volume of the Cactus & Succulent Journal (U.S.) in 1929 generated awareness of E. obesa in the United States. Frick noted the explosive dehiscence of the fruiting capsules and also stated that he knew of no available E. obesa on sale in the U.S., but he did have ten specimens in his personal collection (Frick, 1929). As if to augment Frick's article, a 1930 advertisement in that Journal noted "very rare" E. obesa plants for sale at 10 shillings each from John Coutts of Kendrew, South Africa (the type locality of the species). In 1931, the South African government placed a complete export embargo on E. obesa, which drove the prices in Europe up to the equivalent of $2 per seed, and $10 for a six-month old seedling. It was hoped the embargo would stimulate the natural, uninterrupted reproduction of sizeable numbers in the field (Frick, 1931). South Africa, now a party to CITES, is presently responsible for overseeing exports of this species because it is listed on Appendix II of the treaty.

Except for the pioneering study by McCarten, Campbell, and Gibson (1981), research on the trade in Euphorbia species is devoid of a pre-digested corpus of data from the United States. Before the advent of The Euphorbia Journal in 1983, there was little published information available on the Euphorbia species' biological vulnerability except perhaps what could be gleaned concerning E. obesa. Yet, some connection begins to emerge when we observe, for example, that E. obesa is found beneath karoid shrubs in the Graaff Reinet District near Kendrew, and we discover that in August 1979 the first Karoo Nature Reserve, located at Graaf Reinet, was proclaimed by the Cape Administration (Anon., 1979; Ferreira, 1980). Also, the Beaufort West Reserve was inaugurated in September 1979; reportedly E. symmetrica, a subglobose relative of E. obesa, occurs in the Beaufort West District, and we may hope that the boundaries of these reserves encompass the habitats of these two particular species. Natural vegetation in the reserves is being allowed to regenerate before game antelopes are reintroduced in the future. One hopes that the The Euphorbia Journal, an excellent publication, will remain a source for habitat data on the euphorbias.

The Cape Province of the Republic of South Africa offers much to the Euphorbia enthusiast, although invasive weeds and grazing threaten large areas of prime succulent habitat. It has an arid climate with semi-desert scrub, and is an important sheep grazing region (Taylor, 1973). So important is the region to sheep that Acocks (1953) remarked, "Had the vegetation consisted only of first-class grazing plants, South Africa would long since have become a total desert." A veld (from the Dutch word for "field") is any of the numerous open grazing areas of southern Africa: 70 different "veld types" of distinct vegetation have been identified in the vast region by Acocks (1953). Forty-seven Euphorbia species are components in various veld types. Among them are certain ones characteristic of the Karoo.

The Karoo is the 100,000 square mile tableland (plateau) of the Cape Province, and comprises three divisions: Great or Central Karoo, Upper or Northern Karoo along the Orange River, and the Southern Karoo along the coast. In the Karoo one finds 12 (out of Acocks' total 70) different veld types, one of which is the "noorsveld" with the overwhelmingly dominant "noors" being Euphorbia coerulescens. Appendix C presents a compilation from Acocks (1953) of the Euphorbia species he found to be of floristic consequence in the 12 Karoo and Karroid veld types. A. V. Hall, et al. (1980) have identified the "threatened" euphorbias of southern African countries and the provinces of the Republic of South Africa. The nature of the threats to the majority of species would be agriculture, grazing, or other economic development-oriented jeopardy, rather than trade. In addition, the IUCN Threatened Plants Unit Botanic Gardens Conservation Co-Ordinating Body prepared a list of the status of succulent African Euphorbia species in 1984, adopted as Appendix D to this paper with their permission.

What is the conservation status and prognosis for Euphorbia species occurring in the Karoo veld types? Edwards (1974) observed that "major conservation deficiencies lie in the Karoo and Karroid Bushveld and Grassland Types of vegetation, where 42 veld types have none or virtually no conservation." A map showing the distribution of permanent conservation areas of southern Africa is in Brian Huntley's 1978 article, in which he notes with alarm that "in striking contrast to the conservation status of the Namib, the vast southern African Karoo is almost devoid of conservation areas within the limits of its 557,300 sq. km." One of the regions without protection is the Arid Euphorbia Savanna that covers 2,745 sq. km and is dominated by Euphorbia, Pentzia (Compositae), and Rhigozum (Bignoniaceae) (Huntley, 1978).

The conservation status of southern African vegetation types has more recently been reviewed by Brian Huntley and Shirley Ellis (1982). For South Africa's semi-desert karoo biome, Huntley and Ellis observed that the winter-rainfall karoo of the type known as "succulent dwarf shrubland" in the Namaqualand Coast Belt, which is characterized by 18 species of Ruschia (Mesembryanthemaceae) and 7 Euphorbia species and covers a total expanse of 33,178 sq. km, only 5 sq. km (or 0.01 percent) of the land is conserved. Similarly, in

the summer-rainfall karoo of a desert shrubland type (Orange River Broken Veld) dominated by Aloe dichotoma (Liliaceae) and Euphorbia avasmontana, which covers a total area of 33,371 sq. km, only 95 sq. km (or 0.3 percent) of the land is conserved. Botanically, most of southern Africa (except for the unique Cape Floral Kingdom) remains only moderately well-known, especially for succulent plants which are notoriously difficult to prepare as dry herbarium material (Hepper, 1979). More intensive research is needed in this region, which is plagued by sheep overgrazing, the spread of desertification into already marginal lands (see maps by Mabbutt, 1984 and Dregne, 1984), and invasions of pestilential weeds.

Even thirty years ago, Acocks (1953) observed of the Noorsveld that "owing to the ability of goats to eat chopped Euphorbia caerulescens, as a last resort in drought, this veld type has suffered particularly badly from overgrazing, and in its present condition is often seen dimly through a sand storm."

With regard to invasive exotics, someone realistically remarked, "try to tell a man on the Cape Flats the evils of alien vegetation when he is using that vegetation for fuel and shelter and see what he thinks of conserving the fynbos*" (Anon., 1980).

Responsibility for the spread of marginal to useless lands (amid veld types containing sizeable Euphorbia populations, as we may assume) has been laid onto the South African agricultural community (Anon., 1980a); a situation explained as follows by the Wildlife Society of Southern Africa:

> The real cause is the lack of an appreciation of conservation principles by most of the country's 77,000 white farmers who control 71 percent of the nation's land, while overgrazing in black Bantu homelands -- where some 33 percent of the country's 25 million people occupy 12 percent of the land area -- has reduced many areas to virtual deserts.

Cooperation of the farmers in saving endangered plants is essential and the logic behind it has been discussed in a number of papers. For example, Hall and Rycroft (1979) aptly summarize this problem by saying:

> Over the vast territories of Southern Africa the conservation of rare plants in the wild very often rests solely on private initiative. Agriculture is today one of the major threats to rare plants in the region. Farmers have to provide food and other products for a population that is increasing by 60,000 persons a month. It is generally the

*Fynbos is the gravely endangered and endemic Proteaceae-Ericaceae-Restionaceae community of the Cape.

farmer's decision whether to plow up an area of wild vegetation, to introduce grazing, or to spend hard-earned funds on suppressing invasions by alien plants that smother the indigenous flora.

Hall's (1981) paper on information handling for Southern Africa's Rare and Endangered Species Survey echoes these observations and seeks to conserve as many species as possible. A recent paper by S. P. Fourie (1984) discusses IUCN conservation and legal status of various threatened euphorbias in the Transvaal.

Commercial Trade in Euphorbia

Details of euphorbias traded commercially from 1978 to 1979 were assembled by McCarten, et al. (1981) and are given here as Appendix E (also see McCarthy, this volume). Exports from the Dominican Republic to the United States comprised the largest part of the period's activity. McCarten, et al. (1981) compiled trade figures and their comments indicate that in 1978, Madagascar exported 380 Euphorbiaceae, mostly to Japan (137) and the United States (110). In 1979, the Madagascar figure rose to 830 exported Euphorbiaceae, most of them destined for the U.S. (350), the U.K. (191) and Japan (135). Additionally, collectors reduced the population of Euphorbia abdelkuri on an island near Socotra to 4 individuals and removed 450 plants of Euphorbia turbiniformis from Somalian habitat in order to attempt the growth and propagation of both species.

While several common, even locally dominant species of succulent Euphorbia may warrant removal from CITES Appendix II, it appears obvious that the subglobose species should be specially studied for eventual Appendix I status. The governments of South Africa, Madagascar, Somalia, and other African countries deserve the support and commendation of the world's plant conservationists for any initiatives they may take to ameliorate Euphorbia habitat deterioration and overcollection of species.

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Appendix A

Convergent Succulent Plant Groups

Euphorbia cactus of southern Arabia and cereoid cacti of Latin America.

Euphorbia didiereoides of Madagascar and Didiereaceae of Madagascar.

Euphorbia pachypodioides of Madagascar and *Pachypodium* (Apocynaceae) of Madagascar.

Euphorbia pseudocactus of Natal, South Africa and cereoid cacti of Latin America.

Euphorbia stapelioides of Namibia (Southwest Africa) and Cape Province, South Africa and *Stapelia* (Asclepiadaceae) of South Africa.

Idria columnaris (Fouquiereaceae) of Baja California, Mexico and Didiereaceae of Madagascar.

Aloe dichotoma (Liliaceae) of South Africa and *Dracaena draco* (Agavaceae) of Canary Islands.

Trichocaulon cactiforme (Asclepidaceae) of South Africa and globular cacti of New World.

Aloe polyphylla (Liliaceae) of South Africa and *Agave arizonicus* (Agavaceae) of United States.

Nananthus aloides (Mesembryanthemaceae) of South Africa and *Aloe* (Liliaceae) of South Africa.

Crassula mesembryanthoides (Crassulaceae) of South Africa and Mesembryanthemaceae of South Africa.

Euphorbia opuntioides of Angola and *Opuntia* cactus of New World.

Anacampseros (Portulacaceae) of South Africa and *Crassula* of South Africa.

Andromischus (Crassulaceae) of South Africa, and *Haworthia* (Liliaceae) of South Africa.

Haworthia agavoides (Liliaceae) of South Africa and *Agave* (Agavaceae) of New World.

Appendix B

Early Recorded Succulent Plant Introductions to Cultivation, Largely to Amsterdam

Species	From	To	Year
Agave americana	Mexico	Padua	1561
Aloe africana	South Africa	Amsterdam	1702
Aloe arborescens	South Africa	Amsterdam	1698
Aloe brevifolia	South Africa	Amsterdam	1700
Aloe commixta	South Africa	Amsterdam	1700
Aloe ferox	South Africa	Amsterdam	1700
Aloe glauca	South Africa	Amsterdam	1697
Aloe humilis	South Africa	Amsterdam	1701
Aloe plicatilis	South Africa	Amsterdam	1701
Aloe saponaria	South Africa	Amsterdam	1700
Aloe succotrina	South Africa	Amsterdam	1685
Aloe variegata	South Africa	Amsterdam	1690
Aloe vera	Arabia	Codex Aniciae Julianae	512
Cotyledon orbiculata	South Africa	Amsterdam	1706
Crassula capitellata	South Africa	Amsterdam	1701
Crassula coccinea	South Africa	Amsterdam	1705
Euphorbia antiquorum	Ceylon	Amsterdam	1697
Euphorbia balsamifera	Canary Islands	Amsterdam	1699
Euphorbia canariensis	Canary Islands	Amsterdam	1690
Euphorbia caput-medusae	South Africa	Amsterdam	1703
Euphorbia clava (seeds)	South Africa	Amsterdam	1700
Euphorbia mammillaris	South Africa	Amsterdam	1702
Euphorbia mauritanica	South Africa	Amsterdam	1689
Euphorbia neriifolia	India	Amsterdam	1700
Euphorbia nivulia	India	Amsterdam	1690
Euphorbia officinarum	Morocco	Brussels	1570
Euphorbia pugniformis	South Africa	Amsterdam	1679
Euphorbia tirucalli	Ceylon	Amsterdam	1697
Euphorbia trigona	West Africa	Amsterdam	1697
Gasteria carinata	South Africa	Amsterdam	1700
Gasteria disticha	South Africa	Amsterdam	1700
Gasteria nigricans	South Africa	Amsterdam	1703
Gasteria verrucosa	South Africa	Amsterdam	1706
Haworthia arachnoides	South Africa	Amsterdam	1701
Haworthia margaritifera	South Africa	Amsterdam	1701
Haworthia marginata	South Africa	Amsterdam	1700
Haworthia minima	South Africa	Amsterdam	1694
Haworthia retusa	South Africa	Amsterdam	1699
Haworthia venosa	South Africa	Amsterdam	1701
Haworthia viscosa	South Africa	Amsterdam	1700
Mammillaria mammillaris	Curacao	Leiden	1687
Opuntia curassavica	Curacao	Amsterdam	1690
Pedilanthus tithymaloides	Latin America	Amsterdam	1688
Sansevieria hyacinthoides	South Africa	Amsterdam	1690
Stapelia hirsuta	South Africa	Amsterdam	1699
Stapelia variegata	South Africa	Leiden	1686

Source: Wijnands, 1983.

Appendix C

Selected Euphorbias of the 12 Karoo and Karroid Veld Types of South Africa.

1. Valley Bushveld
   a. Northern Variation: E. tirucalli, E. ingens, E. triangularis; also E. pseudocactus.
   b. Southern Variation: E. triangularis; also E. tetragona, E. grandidens.
   c. Fish River Scrub: E. bothae, E. pentagona, E. tetragona; also E. mauritanica, E. rectirama
   d. Sundays River Scrub: E. ledienii; also E. pentagona, E. rectirama, E. mauritanica.
   e. Gouritz River Scrub: E. burmannii, E. mauritanica, E. clava.
2. Noorsveld: E. caerulescens ("noors," overwhelmingly dominant).
3. Succulent Mountain Scrub or Spekboomveld: E. grandidens, E. mauritanica, E. rectirama.
4. Karroid Broken Veld
   a. Great Karoo: E. arida, E. stellaespina, E. inaequilatera.
   b. Little Karoo: E. mauritanica, E. burmannii, E. mundii, E. rectirama, E. stolonifera.
5. Central Upper Karoo: E. aequoris.
6. Western Mountain Karoo
   a. Upper Form: E. mauritanica, E. stolonifera, E. multiceps.
   b. Lower Form: E. mauritanica, E. stolonifera, E. multiceps.
7. Arid Karoo
   a. Blomkoolganna Veld: E. fusca, E. inaequilatera.
   b. Driedoring Veld: E. rectirama.
   c. Semi-succulent Southern Form: E. stolonifera.
8. Central Lower Karoo: None listed.
9. Succulent Karoo
   a. Namaqualand Coast Belt: E. mauritanica, E. mundii, E. hamato, E. loricata, E. decussata, E. burmannii, E. shoenlandii.
   b. Tanqua Karoo: E. decussata, E. mauritanica, E. mundii.
   c. Steytlerville Karoo: E. inermis.
10. Orange River Broken Veld
   a. Typical Form: E. avasmontana, E. glaucella, E. spinea, E. dregeana.
   b. Rhigozum trichotomum Veld of the Plains: E. gariepina.
11. Namaqualand Broken Veld
   a. Typical Form: E. dregeana, E. mauritanica, E. burmannii, E. mundii.
12. Strandveld
   a. Dense Strandveld Scrub: E. burmannii, E. mauritanica, E. marlothiana.
   b. Open Stranded Proper: E. burmannii.

Source: Acocks, 1953.

Appendix D

Status of Succulent African Euphorbia Species
Numbers of endemic and non-endemic species and infraspecific taxa in each country, by country

Country	Endemic							Non-endemic						
	Ex	E	V	R	I	K	nt	Ex	E	V	R	I	K	nt
Angola				3	17	10					1	3		
Bophuthatswana		1							1					
Botswana						1							4	
C. African Republic						2								
Cameroon					1								1	
Cape Province			2	2										
Djibouti												1		
Ethiopia		3		1	3	4				4	3	1	3	
Ghana												1	1	
Kenya		8	6	3	2				1	9	5			1
Lesotho													1	
Malawi				3									7	
Mali											2		1	
Mozambique				3		9							4	
Namibia					1	13							10	
Nigeria													2	
Senegal											1		2	
Somalia		4	6	7	7					1	1		3	
South Africa		3	9	9	9	48				1			12	

Appendix D

Status of Succulent African Euphorbia Species
Numbers of endemic and non-endemic species and infraspecific taxa in each country, by country

Country	Endemic							Non-endemic						
	Ex	E	V	R	I	K	nt	Ex	E	V	R	I	K	nt
Sudan						1				1		1	2	
Tanzania		6	5	2		3				1	8	2	2	
Togo													1	
Uganda			2						1		2		2	
Upper Volta													2	
Zaire						2							2	
Zambia					1	5							8	
Zimbabwe			2			4				1			9	
World Category		26	34	39	41	102				9	3	2	40	

Symbols: Ex=Extinct, E=Endangered, V=Vulnerable, R=Rare, I=Indeterminate, K=Insufficiently Known, nt=Not Threatened

Source: IUCN/Threatened Plants Unit.

Appendix E

Exports of Euphorbia Plants in 1978-1979

Year	Country of Export	Quantity	Destination	Materials	Reporting Country
1978	Dominican Rep.	59,865	U.S.	plants	U.S.
1979	South Africa	5,770	U.S.	root cut.	U.S.
1978	South Africa	5,000	U.K.	plants	U.K.
1979	South Africa	2,876	Netherlands	root cut.	South Africa
1979	Mexico	2,350	U.S.	plants	U.S.
1979	South Africa	1,850	Belgium	root cut.	South Africa
1978	South Africa	1,484	F.R. Germany	root cut.	South Africa
1978	South Africa	1,472	U.S.	plants	U.S.
1978	Guatemala	750	U.S.	plants	U.S.
1979	Madagascar	357	U.S.	plants	Madagascar
1979	Mexico	300	U.S.	plants	U.S.
1979	Madagascar	191	U.K.	plants	Madagascar
1978	Madagascar	147	Japan	plants	Madagascar
1979	Madagascar	135	Japan	plants	Madagascar
1978	Madagascar	110	U.S.	plants	Madagascar

Source: McCarten, et al., 1981.

The Western European Trade in Cacti and Other Succulents*

Sara Oldfield**

Introduction

Cacti and other succulents have been widely grown in Europe for at least the past century. Most of the species are well-established in cultivation and have long been artificially propagated by amateur growers and commercial nurseries. At the same time, however, wild specimens of certain species have been continually imported from their countries of origin. Concern about the effects of such international trade led to the inclusion of all Cactaceae and certain other succulents in the Appendices of The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1973.

CITES listing of these plants brought about the control of international trade in the taxa concerned, which allowed monitoring of the levels of trade. Of the European countries that are CITES parties, however, only the United Kingdom (U.K.) has published data on CITES plant imports in any detail. With the inception of the provisions of European Economic Community (EEC) Regulation (3626/82) on CITES in January 1984, other EEC countries are also now required to provide trade data on CITES-listed species.

Europe undoubtedly remains an important market for succulent plants imported from their native habitats, but the nature and extent of the trade has only previously been studied for the U.K. (Jarvis, 1979). It is now particularly important to view the trade in a European context because the EEC Regulation provides a common external border for CITES controls.

The current survey was carried out between January and June 1985. The main aims were:

1) to determine volumes and patterns of trade within Europe of wild and artificially-propagated cacti and other succulents;

2) to assess the effectiveness of CITES, EEC, and national legislation controlling trade in rare species;

3) to assess the role of nurseries in helping to conserve rare plants through propagation;

4) to determine the extent to which non-CITES species may benefit from international protection.

*Editors' note: This chapter first appeared in 1985 in the IUCN Traffic Bulletin Vol. VII Nos. 3/4. Ms. Oldfield and Mr. Jonathan Barzdo (WIMU) kindly allowed us to reproduce it here. Since that time Spain and Portugal have joined the EEC.

**Ms. Oldfield is a Consultant to the Wildlife Trade Monitoring Unit (WIMU) of the IUCN Conservation Monitoring Centre, 219c Huntingdon Road, Cambridge CB3 ODL, United Kingdom.

Within Europe there are well-established links for the trade in succulent plants between various countries. These operate at both the wholesale and retail level. Wholesale production is, for example, carried out in southern France, Spain, and Italy to supply firms in northern Europe. Specialist collector interest in succulents is mainly concentrated in Belgium, F.R. Germany, the Netherlands, and the United Kingdom. In these countries, specialist nurseries supply the species that are rare in the wild and cultivation. At the same time, countries such as the Netherlands and Denmark have an important commercial production of succulents as part of the pot plant trade.

The scope of this survey covers the EEC countries with an emphasis on the U.K. trade, as well as Austria, Malta, Spain, and Switzerland, where the succulent plant trade is also important. Incidental information on the trade in other countries, such as Sweden and the USSR, has been collected for storage at the Wildlife Trade Monitoring Unit (WTMU) of the International Union for Conservation of Nature and Natural Resources (IUCN) in Cambridge, U.K. but is not included in this chapter.

Cacti and the other succulent plant groups are renowned for taxonomic and nomenclatural problems. This is in part a direct result of the intensive cultivation and study in cultivation of these plants away from their natural habitats. The term "succulent" is itself very broad and open to interpretation. Cacti are defined botanically as a distinct family. The other succulents cover a wide range of families and, as Rowley (1980) points out, "The amateur grows anything that in looks and cultural requirements blends with his cacti, agaves, crassulas and unquestionable succulents, frequently stretching the limits where rarity or novelty is involved." This survey covered the same ground.

Methods

The primary source of trade data used in this survey was the annual report of CITES party states. Availability of the CITES data is hindered by the fact that the U.K. is the only European country that has published detailed information on plants in annual reports. With the exception of 1981, all U.K. data since 1976 have been reported only at generic level for plants that are listed in Appendix II at family level.

The most detailed CITES information on cacti and other succulents is provided in the annual report of the United States. Other countries, such as Madagascar and South Africa, also provide useful export trade information. Unfortunately, the data in CITES annual reports are rarely subdivided into wild and artificially-propagated plants. Even where they are, some caution is necessary in accepting the information as correct. Trade through specialist "nurseries" may all too easily be assumed to consist entirely of artificially-propagated plants.

The second source of information included nursery plant lists and catalogues, some of which provide particularly interesting comments on cultivation and conservation. Most of the catalogues were obtained from U.K. nurseries, but some were also obtained directly from nurseries in the Netherlands and F.R. Germany. The plant lists and catalogues show the very wide range of cacti and other succulents available. They also show the wide range of names used in trade for the same species. Generally, in this report the names given by traders have been used. An exception is made for CITES Appendix I species where the names used by various nurseries have been standardized. In addition, Annex 1 gives names, where known, which are generally considered to be synonyms, used in the Tables in this report. It is often very difficult to relate trade names of cultivated plants to botanically "acceptable" species names and this makes it particularly difficult to relate the trade situation back to wild populations.

The third source of information was correspondence and interviews with CITES Management Authorities, TRAFFIC offices, other conservation organizations, botanists, and nurserymen. In addition, a number of visits to nurseries were made during the survey, either by arrangement or unannounced. Whenever possible, a list of the species on sale was prepared, with an assessment of which species were wild-collected, how many specimens were available, and at what prices. Details of the visits are not included in this chapter but are available to the relevant CITES Management Authorities.

Trade in cacti

Cactus production in European nurseries occurs on a huge scale, as exemplified by the national production figures for Denmark (p. 62) and Spain (p. 53). The bulk of the production in Europe is independent of wild-source material, including seed. Some species that are rare or threatened in the wild, such as Echinocactus grusonii and Mammillaria carmenae, are commonly propagated. Very little information is available on threatened species of South American cacti but it is possible that commonly-propagated species of Rebutia and Sulcorebutia, for example, may include some which have restricted distributions in the wild. However, the artificial propagation of rare cacti is not generally in direct response to conservation needs.

The emphasis in commercial cactus cultivation is on quick-growing and free-flowering species. Rarity is only an important factor to specialist nurseries supplying the more serious collector.

Cactus seed is quite readily available in Europe but several U.K. nurserymen, particularly those in recently established nurseries, find their ability to grow rare species restricted by seed availability. Some traders concentrate partly or exclusively on the sale of seed. Two important suppliers to nurseries and amateurs are de Herdt and Kohres. One of the main U.S. suppliers, Steven

Brack, has agents in F.R. Germany and the United Kingdom. During a meeting of the CITES Technical Committee Plant Working Group in Tucson, Arizona (spring 1984), Brack commented that most of the seed in the world industry comes from France and Spain.

Seed of endangered cacti is available now through general retail outlets. For example, Thompson and Morgan, a U.K. seed firm, offers seed of Echinocactus grusonii, Obregonia denegrii, Pelecyphora aselliformis and Turbinicarpus species.

The commercial production of cacti mainly involves raising the plants from seed. Cuttings provide an alternative method of propagation for those species that form side shoots. Grafting is a fairly common practice in cactus propagation and is particularly popular in Belgium. It is used for cacti that are difficult or slow-growing in cultivation and can be used either for seedlings or for cuttings, which are grafted onto stock plants of fast-growing species.

Despite the availability of propagated cacti of both common and threatened species, there is still a demand for wild-collected cacti, including Appendix I species that can be purchased in Belgium, the Netherlands, and F.R. Germany. It appears from CITES statistics that most of the Mexican species on Appendix I entering European trade were reexported from the United States. Now, however, European nurseries also import cacti directly from Mexico, largely because the U.S. Wildlife Permit Office (Management Authority for CITES) is issuing fewer reexport permits (Fuller, in litt.).

Very few CITES data exist on European imports of South American cacti. The U.K. has recorded the import of small numbers of Copiapoa specimens, for example, but there is no doubt that large quantities of Chilean and Brazilian cacti enter F.R. Germany and the Netherlands unrecorded.

Genera of Cactaceae Particularly Threatened by Trade

Certain genera of Cactaceae are considered particularly sensitive to the effects of trade because they have a high proportion of threatened species, which are also particularly sought after by collectors and may be relatively difficult to propagate. The U.K. enforces stricter domestic measures for these genera than required by the terms of the EEC Regulation on CITES. Visits to nurseries in Belgium, the Netherlands, and F.R. Germany revealed a much wider availability of wild-collected specimens of these genera than in the United Kingdom. A number of species within the genera are listed in CITES Appendix I and are therefore subject to strict trade controls internationally.

The following notes summarize information on those genera of cacti that are thought to be particularly sensitive to the effects of trade. The conservation status of species in the wild is given where known, according to IUCN Red Data Book

(RDB) categories assigned by IUCN's Threatened Plants Unit for Mexican endemic species. For a definition of the Categories see Lucas and Synge (1978). The term "threatened" is used in the following notes to encompass all IUCN RDB categories known as Endangered, Vulnerable, Rare, or Indeterminate, except when applied to the genus Coryphantha. For this genus, whose distribution includes the U.S., the U.S. Fish and Wildlife Service categorizes certain species as either "Endangered" or "Threatened" under the U.S. Endangered Species Act (ESA).

A list of threatened and insufficiently known Mexican endemic cacti was published in the proceedings of the fourth meeting of the Conference of the Parties to CITES (Oldfield, 1984). Similar information on the status in the wild of South America cacti is not yet available.

Ancistrocactus

There are two species in this genus, A. tobuschii and A. scheeri, listed in CITES Appendix I. A. tobuschii was not offered by the U.K. nurseries contacted during the survey nor was it seen during visits to continental nurseries. A. scheeri is more common in European trade in the form of propagated plants. In 1983 fifty Mexican specimens of this species were reexported from the U.S. to F.R. Germany.

Ariocarpus

This is a genus of six slow-growing species, five of which are Mexican endemics recognized as Threatened by IUCN. Three of these, A. agavoides, A. scapharostrus, and A. trigonus are listed on CITES Appendix I.

In the U.K., wild-collected plants of CITES Appendix II species A. fissuratus and A. retusus — another Mexican endemic — are on sale at several nurseries but the demand for Appendix I species appears to be met by seedlings. According to one U.K. nurseryman, A. agavoides and A. scapharostrus are the two species of the genus that adapt most readily to cultivation (Mottram, in litt.). A. agavoides has flowered at six years from seed in cultivation (Preston-Mafham, in litt.). According to Preston-Mafham, A. kotschoubeyanus and A. trigonus together with A. agavoides, will grow from seed but other species never really come to resemble wild plants. It has been suggested by another nurseryman that prohibiting the sale of certain wild-collected Ariocarpus species encourages propagation and forces collectors to buy small plants, which they would not purchase if mature imported plants were available (Comer, in litt.). Wild-collected Appendix I Ariocarpus species are still on sale elsewhere in Europe, however. One West German nursery visited during the survey had about 50 wild plants of A. agavoides openly on display along with smaller numbers of the other two Appendix I Ariocarpus species. Similar plants were available at other German nurseries and many A. trigonus were seen at a wholesale plant warehouse.

Aztekium ritteri - Appendix I

One of the slowest of all cacti to propagate from seed, this monotypic genus is not currently offered by U.K. nurseries, but wild-collected plants are available from a Belgian nursery.

Backebergia militaris - Appendix I

A monotypic genus endemic to Mexico with an IUCN RDB category of Indeterminate, this species is not currently offered for sale in the United Kingdom. Despite an Appendix I listing, wild-collected specimens were seen at one Dutch nursery and specimens were recently on sale in Switzerland. It is the topcuts of branches that are sold. According to Mottram (in litt.) few plants of this species are ever imported because, "It is expensive on heating requirements. The cuttings are heavy and the airfreight made them very expensive."

Copiapoa

A Chilean genus with over fifteen species, this genus is in need of further field study to establish proper species limits (Taylor, 1981a). More species names are used for plants in cultivation. For example, Backeberg (1977) gives over forty, and over fifty were extracted from current U.K. nursery catalogues. Most of the plants available in the U.K. are grown from seed but some habitat-collected specimens are also offered, including a relatively high proportion of species imported directly from Chile in recent years. Generally, the numbers of each species reported as imports in U.K. CITES statistics have been low, the largest transaction of a named species being forty-two specimens of C. cinerea imported from Chile in 1983. There are no data to suggest that wild-collected specimens of Copiapoa are re-exported by other European traders to the U.K., although wild-collected plants are readily available from nurseries in F.R. Germany.

Coryphantha

This genus consists of approximately thirty species that grow in Mexico and the southwestern United States. Fifteen Mexican species are considered Threatened or Insufficiently Known by IUCN. One of these, C. werdermannii, is listed in CITES Appendix I together with two U.S. species. Four U.S. taxa are considered "Threatened" or "Endangered" under the U.S. Endangered Species Act (ESA) and sixteen U.S. taxa are candidates for listing under the ESA. Most Coryphantha species can be raised quite readily from seed and there is not thought to be any collector interest in wild plants in Europe. Some species are commercially produced on a large scale.

Discocactus

Five species are currently recognized in this genus by Taylor (1981b). They occur in Brazil, eastern Bolivia, and Paraguay. Discocactus is recognized as one of the most difficult genera to cultivate. Imported plants are hard to establish and suffer from cold winters in the U.K. (Mottram, in litt.), and imports into Europe in the 1970s led to the loss of thousands of plants (Mace, 1980).

The species that may be most vulnerable to over-collecting are D. horstii, an endemic from Minas Gerais, and D. zehntneri, restricted to north Bahia. No wild-collected plants of these species are currently offered by U.K. nurseries. Grafted plants of D. horstii are quite readily available in the European trade. Wild-collected Discocactus species were seen in quantity in F.R. Germany and the Netherlands. There have been no recent Brazilian exports of Discocactus recorded in CITES statistics, though two specimens were reexported from F.R Germany to the U.K. in 1980.

Echinocereus lindsayi - Appendix I

This species is possibly extinct in the wild as a result of over-collecting following its discovery in 1975. It is artificially propagated by at least one nursery in F.R. Germany.

Echinomastus erectocentrus and E. mariposensis - Appendix I

These U.S. species are not currently advertised by U.K. nurseries, although several nurserymen claim to have propagated them. They are difficult to grow from seed (Taylor, pers. comm.) and neither species was seen during visits to nurseries.

Epithelantha

This genus has one variable species, E. micromeris. Six varieties are recognized by IUCN as Endangered, Indeterminate, or Insufficiently Known. Wild-collected specimens are quite commonly seen in trade and are currently offered by nurseries in F.R. Germany and the Netherlands.

Eriosyce

This genus includes one variable species from Chile. Plants were exported from Chile and Peru to the U.K. in 1982 and 1983. A few wild-collected specimens were seen at one U.K. nursery during the survey. They have, however, restricted availability and interest in the United Kingdom. Plants were not noted during visits to nurseries in other countries.

Islaya

This genus consists of four (Donald and Rowley, 1966) to twelve (Backeberg, 1977) species occurring in southern Peru and northern Chile. While they are of

limited interest in the U.K., several species are currently offered. Wild-collected plants were seen at Dutch and German nurseries. Trade in the genus in CITES statistics for 1980-1983 is recorded under Neoporteria.

Leuchtenbergia principis - Appendix I

This monotypic genus is categorized by IUCN RDB as Vulnerable. It is commonly grown from seed in Europe and is one of the most widely available artificially-propagated Appendix I cacti in trade. When grown from seed, it flowers at five years old (Preston-Mafham, in litt.).

Lobeira macdougallii - Appendix I

This monotypic genus is categorized by IUCN as Vulnerable. This species is not currently offered by U.K. traders nor recorded in any CITES annual reports from 1980-1983. It is an epiphytic cactus and, according to Mottram (in litt.), since epiphytic cacti are easily grown from cuttings it is unlikely to be commercially collected from the wild.

Mammillaria pectinifera - Appendix I

Three U.K. nurseries currently offer this species. It is endangered in the wild but can be grown easily from seed (Preston-Mafham, in litt.) and will flower in two to three years (Taylor, pers. comm.). Wild specimens are unlikely to be sold in Europe.

Mammillaria plumosa - Appendix I

This species is considered Vulnerable in the wild and wild-collected specimens have been available in European trade. Specimens were, for example, offered for U.S.$122 at the 1981 British Cactus Sales Fair. It is, however, extensively grown from seed and offsets. Artificially-propagated plants are now widely available from European nurseries. It is not considered to be a specialist plant. M. plumosa is also extensively propagated in the U.S. (Fuller, in litt.). Propagated plants sell for approximately $.60-$1.40 in the United Kingdom.

Mammillaria solisioides - Appendix I

A vulnerable species in the wild, this species is not uncommon in cultivation and is readily available as propagated material. According to CITES statistics, 17,395 artificially-propagated plants were exported from the U.S. to the U.K. in 1983.

Obregonia denegrii - Appendix I

This monotypic genus is categorized by IUCN as Endangered. Three U.K.

nurseries offer artificially-propagated specimens. This genus is easy but slow to raise from seed (Taylor, pers. comm.).

Pediocactus

Eight species of the genus are listed in CITES Appendix I. All species except for P. simpsonii are difficult to cultivate and are severely threatened in the wild. In the U.S. some successful artificial propagation has been done using tissue culture techniques (Starling and Dodds, 1983). Plants of this genus are rarely available from European nurseries. One U.K. nursery advertised P. despainii, P. paradinei, P. papyracanthus (as Toumeya papyracantha), and P. winkleri and it is assumed from the advertisement that these were artificially propagated (Fussell, 1985).

Pelecyphora

Two species are generally recognized in this genus, P. aselliformis and P. strobiliformis, and both are listed in CITES Appendix I. A third species name advertised in trade, Pelecyphora pseudopectinata, is considered to be a synonym of Turbinicarpus pseudopectinatus. Both P. aselliformis and P. strobiliformis are propagated by several U.K. nurseries. According to one nurseryman, however, the seedlings take many years to resemble wild plants. P. aselliformis has been described as "one of the unique phenomena of the vegetable kingdom. The first specimens of P. aselliformis were imported into Europe one hundred years ago, by one or two Belgian nurserymen. For a long time this plant was esteemed as the rarest jewel of any collection" (Barthlott, 1979).

Sclerocactus

Four species of this U.S. genus are listed on CITES Appendix I. According to Backeberg (1977), plants of the genus are difficult to grow and "even grafting seldom provides a longer-term solution." They are uncommon in European trade. Ten plants were imported to the U.K. from the U.S. in 1983 and plants were advertised in 1985 by one U.K. nursery (Fussell, 1985). It is assumed that these were artificially propagated. Plants of this genus were not seen during visits to continental nurseries.

Strombocactus disciformis - Appendix I

A monotypic genus, S. disciformis has an IUCN category of Vulnerable. In 1982, prior to its listing in Appendix I of CITES in 1983, 175 specimens of this Mexican cactus were reexported from the U.S. to the United Kingdom. In 1985 several U.K. nurseries offered seedlings of this species even though it grows very slowly from seed.

Thelocactus

This genus of about ten species, occurs in the U.S. and Mexico. Three Mexican species are recognised by IUCN as threatened. Twenty-four taxa are offered by U.K. nurseries and wild-collected plants are not currently being sold. According to Mottram (in litt.), plants are easily grown from seed. In CITES statistics, five plants were recorded as being imported from Mexico into the U.K. via the U.S. in 1983. Wild-collected specimens are sold in F.R. Germany. Three hundred-thirty specimens of Mexican species were reexported to F.R. Germany by the U.S. in 1983, including 210 specimens of the rare Thelocactus macdowellii. According to Barthlott (1979), T. bicolor "has perhaps the finest flowers of all the spherical cacti, and for this reason it was at one time imported by the thousands from its homelands."

Turbinicarpus - Appendix I

This endangered genus is endemic to Mexico. Plants are much sought after by collectors, but the majority in European trade are now grown from seed. CITES statistics show that a relatively high number of plants were reexported by the U.S. to the U.K. in 1982 and 1983, prior to Appendix I listing. Several U.K. nurserymen have commented that all species are easy to grow from seed, which is commonly available and from which plants will flower at two years.

Uebelmannia

This is a Brazilian genus with three to five species. According to Backeberg (1977), "Cultivated specimens in Britain are mostly imported plants which have shown a discouraging loss rate as they are very slow to establish and require considerable heat. However, both imports and the few available seedlings have been grafted successfully and the natural characters appear unaffected." Recorded imports to the U.K. in 1982 and 1983 mainly originated in Denmark and the United States. Presumably, these were grafted specimens, but wild-collected plants are available in the United Kingdom.

Trade in succulents other than cacti

Cacti dominate the European succulent plant market which supplies both specialist collectors and the general "house plant" trade. The range of other succulents available in trade is extremely diverse including plants of one important family, the Aizoaceae, together with genera and species of over twenty other families. By volume, the succulent plants listed in Figure 1 and Table 3, may be the most abundantly produced. In addition, hardy European and non-European succulents are produced as garden -- usually rockery — plants but their trade is considered outside the scope of this survey.

The present listing of succulent plants in the CITES Appendices is somewhat random and may appear illogical to traders. Trade data on genera and species not

covered by CITES are generally hard to come by but limited data on South African exports are provided for this survey (see Table 2).

Several European nurseries specialize in succulents other than cacti (for example van Donkelaar in the Netherlands and Barleyfield in the U.K.). Both of these nurseries sell only artificially-propagated specimens. Nurseries generally sell a mixture of cacti and other succulents, with cacti being the most varied and abundant plants offered, although interest in "other succulents" appears to be strongest in the United Kingdom.

CITES statistics for 1982 and 1983 indicate that the U.S. and Japan are major exporters of succulent Euphorbia and Aloe species to Europe. The U.S. exports a greater range of species, including a number which are rare in the wild, whereas Japan exports a higher volume. For example, Japan exported 28,400 specimens of Euphorbia species to the Netherlands and 1,400 Aloe specimens went from Japan to F.R. Germany. It is likely that most of these succulents exported by Japan and U.S. are artificially propagated. Campbell (1984) reports, however, that the U.S. exported threatened species of Aloe, which could be of wild origin.

Of greater concern is the export of succulents from their countries of origin. Two countries with a rich succulent flora, Madagascar and South Africa, monitor exports, although Graham (1984) has suggested that wild plants of these countries are imported into Europe "one step ahead of the law."

Madagascan succulents

Madagascar is a major exporter of native CITES succulents to Europe. There is one commercial succulent plant nursery in Madagascar that offers rare species of the genera Aloe, Euphorbia, Pachypodium, Didierea, and Alluaudia. According to Madagascan CITES statistics, all specimens of these succulents exported are artificially propagated, but visitors to Madagascar report that the nursery also has many field-collected specimens (Rauh, 1983; Hardy, in litt.).

Wild-collected Madagascan succulents are currently offered by nurseries in the U.K. and F.R. Germany. It is thought that bulk imports into Europe mainly enter via France. Madagascar records the export of large quantities of Euphorbia species to F.R. Germany, including 200,073 Euphorbia species in 1982 and 82,500 specimens of E. lophogona in 1983. One major West German wholesale nursery has an arrangement with a nursery in the south of France to establish plants imported via Paris.

Propagated specimens of Madagascan succulents are available. For example, Whitestone Gardens in the U.K. has Alluaudia procera cuttings imported from Japan. Certain Madagascan species have become particularly well-established in wholesale production. These include Pachypodium lamerei, some "crown-of-thorn" Euphorbia species and Kalanchoe species such as K. tomentosa. Rauh (1983) points out,

however, that apart from these few species most of the rare Madagascan plants he has seen on sale in nurseries, supermarkets, and flower shops were collected from the wild.

South African succulents

CITES data on imports of South African succulent plants to Europe as reported in the annual reports of Parties are given in Table 1. Trade in cacti is excluded although some species, including Appendix I Leuchtenbergia principis, have been exported to Europe. Data on trade in Aloe ferox are also excluded as this is not for the horticultural market.

Table 1 indicates that the reported volume of trade in named CITES species is very small. The species listed are not currently considered threatened and the specimens are nearly all reported to be artificially propagated.

Visits to European nurseries during this survey did not reveal many South African CITES-listed succulents on sale, and it appears that there is not a high demand for these at present. Wild-collected specimens of Euphorbia bupleurifolia are, however, available from several nurseries.

There is currently greater interest, at least among U.K. collectors, in certain other South African succulent genera not listed on CITES. South African succulents not covered by CITES but which should perhaps be considered for listing in the Appendices are given on page 51. Wild-collected plants of these genera and of some rare species are all currently on sale in Europe. It has been suggested that the demand for these South African succulents is even greater in Japan and the U.S. than it is in Europe (Bayer, in litt.).

Exports of non-CITES succulent species from the Transvaal, South Africa to Europe during 1984 are given in Table 2. The data refer to "cultivated" plants exported by three nurseries. Four other specialist nurseries also export succulents from South Africa.

According to van Jaarsveld (in litt.), the latest fashion in succulent plants is for the genus Haworthia and for caudiciform plants. He considers these plants, including Fockea spp., the most likely to be field collected and illegally exported from South Africa. Another caudiciform species common in trade and currently offered in the U.K. and elsewhere in Europe as is wild-collected Dioscorea (Testudinaria) elephantipes, the popular "elephant's foot." Wild-collected plants of this South African species were seen at a wholesale plant nursery and one other nursery in F.R. Germany. Walker (1985) has reported that Adenia species (also caudiciforms) are often in cultivation as wild-collected plants.

Relatively few Haworthia species were seen during visits to continental

nurseries, and all appeared to be propagated. It is likely, however, that rare wild-collected Haworthia species have been sold in the U.K. (Oldfield, 1983) where interest in the genus is currently concentrated. According to Mottram (1985), the genus has "emerged from comparative obscurity in recent years, stimulated by a wealth of new literature." One new specialist nursery advertised the genus for the first time in June 1985. Another U.K. nursery offers a list of "specially selected Haworthias imported direct from South Africa," at prices that suggest they are wild-collected. Rare species currently offered by the nursery include H. sordida at $27 and H. springbokvlakensis at $20-$23. Several other U.K. nurseries also offer rare Haworthia species which are thought to be wild collected.

The South African family Aizoaceae rivals the Cactaceae as the largest succulent plant family and is very popular in trade. There is thought to be very little trade in wild-collected specimens of the family since plants grow easily from seed. However, it is considered likely that some species are wild-collected, including Conophytum burgeri, Gibbaeum nebrownii, Muiria hortenseae, Pleiospilos archeri, and P. hilmarii (van Jaarsveld, in litt.). Several U.K. nurseries do offer P. hilmarii grown from seed.

Trade in individual countries

U.K.

The U.K. implemented CITES for plants in 1976 and the Endangered Species (Import and Export) Act of 1976 came into force the following year. The first U.K. annual report to CITES, which included data on cacti and other succulents, was produced for 1976. Since the inception of the plant trade legislation, one independent survey of the U.K. CITES succulent plant trade has been carried out (Jarvis, 1979).

Since 1979, changes in the U.K. legislation incorporating amendments to the CITES Appendices through the Wildlife and Countryside Act of 1981 and the implementation of the EEC CITES Regulation have significantly altered trade controls. More legal restrictions are now in force, creating the need to reassess the trade situation. At the same time, data on U.K. cacti and other succulent plant imports are increasingly available due to more effective reporting by exporting countries.

The overall assessment of retail trade outlets remains the same as that provided by Jarvis (1979). He described the two main categories of outlets as specialist nurserymen and more general retailers such as florists and supermarkets. In the U.K. there are also several specialist nurseries producing succulents on a wholesale basis, though on a considerably smaller scale than foreign wholesale nurseries that export to the U.K., such as Edelman in the Netherlands.

Jarvis (1979) found over 35 specialist cactus and other succulent plant nurseries in the U.K. As part of the current survey, an index of addresses of 50 nurseries and 3 specialist seed suppliers were drawn up from recent editions of the British Cactus and Succulent Journal. The majority of these nurseries operate on a part-time basis. They do not all advertise regularly.

Out of 41 nurseries and 1 seed specialist written to as part of the survey, 27 replied and several said they were closing down. Nurseries were asked for copies of their current plant lists and also for comments on the U.K. conservation legislation, the species protected, and their propagation. Twenty catalogues or plant lists were received and of the nurseries not producing lists, five indicated which Appendix I species they are propagating. In addition, a number of nurseries reported propagating Appendix I cacti not currently advertised.

U.K. nurseries propagate most Appendix I cacti, including Mammillaria plumosa, Leuchtenbergia principis, and Turbinicarpus species. No evidence was obtained during the survey of wild-collected Appendix I species being offered to the public, but nurseries do have wild-collected "mother" plants for seed production. One nurseryman produces 1,500 seeds of Pelecyphora aselliformis each year for sale from imported habitat plants.

Appendix I succulents other than cacti are scarcely available in the United Kingdom. As Jarvis (1979) pointed out, "Relatively few nurseries... sell habitat-collected plants and such plants can play a significant part in the trade for no more than three or four British nurseries." The same seems to be true today but four of the seven nurseries visited had a few wild-collected plants. One of the nurseries was a very small part-time concern and it is possible that similar nurseries that did not respond to the survey have a few habitat plants. Only one catalogue specifically indicates wild-collected species.

No U.K. nursery deals in wild-collected succulents to the same extent as the traders in Belgium, F.R. Germany, and the Netherlands. British succulent enthusiasts are able to buy directly from these continental nurseries either by mail or during visits, often organized by branches of the British Cactus and Succulent Society.

Wild-collected cacti on sale in the U.K. include Appendix II species of Ariocarpus, Copiapoa, and Discocactus. Although a high proportion of such plants was reexported to the U.K. from other European countries, CITES statistics show that, at least for Copiapoa species, plants were imported directly from the country of origin, Chile.

At least 15 nurseries contacted stated specifically either in their catalogue or in correspondence that they sell only propagated material, in some cases expressly because they favor conservation. Dale (in litt.), for example, states that in over 50 years of growing cacti he has never imported any wild-collected

plants and propagates Appendix I cacti and Agave species from seed. Abbey Brook nursery states in its catalogue that in 1968 it was the "world's first commercial cactus nursery to make a public declaration against the importation and sale of unpropagated wild collected plants." The nursery has a "conservation collection" used to produce nearly two million seeds per year. Mr. Graham, editor of The Xerophyte and owner of Barleyfield Succulent Plant Nursery, feels that "there is no need at all for the commercial importation and sale of succulent plants" (Graham, in litt.). Another nurseryman suggested a complete ban on retail sale of wild-collected succulents with limited quantities of documented stock plants being distributed to licensed nurseries for propagation (Comer, in litt.).

Several nurserymen believe that conservation legislation should make some wild-collected plant material available for propagation purposes. Seed availability was said to be a factor influencing the propagation of rare species. Abel (in litt.) believes that any controls on exports of wild-collected material should exclude seed. Westfield nursery is building up stocks of seed-grown endangered species for future seed production, partly because of the high cost of importing seed from the U.S. where a fee is required for a license to export Appendix I seed (Northcott, in litt.).

Nurserymens' concern about the current conservation legislation focused mainly on provisions for sale of Appendix I artificially-propagated plants and the export of artificially-propagated material. Under the EEC CITES Regulation, Appendix I plant specimens can only be sold if they are artificially-propagated (or under certain other circumstances relating to the date of acquisition). There is some uncertainty among traders as to whether a license is required to sell artificially-propagated material. Several nurseries have requested permission from the Department of the Environment (U.K. CITES Management Authority) to sell Appendix I specimens. Two nurseries received this permission following nursery inspections and many other nurseries advertise and sell propagated Appendix I plants. It seems that some general exemption is necessary.

Traders commonly criticize the U.K. legislation for its requirement of export permits for nursery-raised plants, particularly for each individual consignment. They believe that this acts as a disincentive to propagation and trade, whereas these should be encouraged. Mottram (in litt.) suggests that since U.K. traders may "acquire their stock either by propagation or by legitimate importation," a system of licensing traders would be appropriate, rather than licensing individual consignments.

Stricter U.K. trade controls on certain genera of cacti have provoked a backlash against conservation, as expressed by Whitely (1984), who complained about the "blanket ban on Copiapoa imports" and added that "conservation laws in their brief history have probably killed more plants than collectors have ever collected since man first took an interest in cacti." Unfortunately, Whitely's article was quoted by several nurserymen in response to the current survey.

Belgium

Enforcement of CITES in Belgium began with the implementation of the EEC CITES Regulation on 1 January 1984. The first Belgian annual report to CITES was produced for 1984. The report includes data on exports of cacti and Euphorbia species, although it does not give genera and species of cacti. The report gives no information on the import of CITES succulent plants.

CITES data provided by exporting countries give scant information on Belgian imports of these plants. For example, the only exports recorded in the 1983 annual report were 31 artificially-propagated plants of 33 species exported from the U.S. to Belgium that year, although interviews with nurserymen indicated that imports of artificially-propagated specimens were considerably more substantial than this. In addition, imports of wild-collected CITES plants have clearly taken place.

According to van Meines (1981), specific data on Belgian production, sale, and use of cacti are unobtainable, but sales have dropped significantly due to competition with the Netherlands. Particularly close trading links exist between Belgium and the Netherlands and no plant health checks are required for the movement of plants between the two countries. This means, in effect, that there are no CITES controls on artificially-propagated Appendix II cacti and other succulents moving between these countries.

The CITES plant trade in Belgium is controlled by the plant health service, Protection Vegetaux, of the Ministry of Agriculture. There are no personnel solely responsible for CITES matters within this agency.

According to Protection Vegetaux, there are ten cactus producers in Belgium. One of these firms visited during the survey is actually a wholesale pot plant supplier, which does not appear to produce cacti but sells a range of small unnamed cacti produced elsewhere together with other pot plants (including a few wild-collected cycads). Of the firms specializing in cacti and other succulents, only two are known to sell wild-collected plants. A visit to one during the survey revealed wild-collected Aztekium ritteri for sale.

In Belgium, an amateur group known as ABC (Aktiegroep voor de bescherming van cactussen en andere planten) was formed to promote succulent plant conservation by encouraging propagation and discouraging the purchase of wild-collected plants. The group has publicized plant conservation and CITES through articles in Succulenta, a magazine for Belgian enthusiasts, and through talks to local specialist groups. ABC is now working closely with TRAFFIC(Belgium).

Belgium's close proximity to major Dutch and German specialist nurseries clearly increases the availability of rare cacti and other succulents to Belgian collectors.

The sale of wild-collected succulents in the non-specialist pot plant trade also gives cause for concern in Belgium. Specimens of Beaucarnea and Nolina have been sold through florists and are also sold as large specimens for office reception areas (Bourdoux, in litt.). Currently, only one species of these genera, Nolina interrata, is covered by CITES, but this type of trade clearly needs to be monitored wherever possible.

Denmark

Denmark is primarily a producer and exporter of cacti and other succulents but some commercial imports also take place, as reflected in the CITES statistics and annual reports of exporting countries. The U.S., for example, exported over 100,000 cacti to Denmark in 1982, although it did not export any in 1983 (Campbell, in litt.).

The Danish Management Authority has never published detailed CITES trade data for plants. The trade is dominated by artificially-propagated specimens. Estimates of the production of cacti and other succulents in Denmark are given in Table 3. All the plants listed in Table 3 are included in CITES Appendix II except for Pachypodium namaquanum, which is on CITES Appendix I.

There is no evidence to suggest that Danish nurseries sell wild-collected plants of either CITES Appendix I or Appendix II plants. It is likely that specialist collectors buy rare species from nurseries elsewhere in Europe, either by mail or in person.

Import and export controls on CITES plants are operated by the Plant Protection Service, which plans to extend the use of phytosanitary certificates to all trade in CITES-listed plant species.

F.R. Germany

F.R. Germany's trade in cacti and other succulents has never been reported in its CITES annual reports. Officially, all trade in such plants has been stated to be in artificially-propagated specimens. Furthermore, F.R. Germany interprets the annotation "Cactaceae spp. (all species of the family in the Americas)" in Appendix II to mean that only imports from the Americas have to be controlled.

Reported exports by other CITES parties, however, show F.R. Germany to be a major destination of both artificially-propagated cacti and other succulents. According to Leuenberger (in litt.), the demand for wild-collected plants still exists and very few collectors actively propagate wild-collected material. Appendix I species are advertised in a number of nursery catalogs and continue to be openly displayed for sale by those nurseries. One nursery includes nine Appendix I species in its 1985 plant list, and a visit revealed that all were

wild-collected. Plants of the genus Turbinicarpus, which most nurserymen agree can be easily grown from seed, were particularly abundant.

There are about 30 cactus and succulent nurseries in F.R. Germany. Five nurseries known to trade in wild plants were visited during the week 5-12 April 1985. In addition, Bisnaga, a large nursery that trades only in propagated plants, was visited. This nursery produces about 1,000 different species and indicates in its catalogue whether plants are grafted or raised from seed.

EEC trade in CITES specimens is regionally controlled in F.R. Germany by the individual states. The states have compiled a list of nurseries that carry out legal propagation, consisting of eight firms (Blanke, in litt.). Of these firms, three visited during the survey also carry out a major trade in wild-collected plants, which may be known to the German Management Authority.

The continuing German trade in wild-collected rare cacti and other succulents is a cause for concern. It appears to be largely overlooked by the CITES authorities, presumably because it is masked by a large trade in cultivated plants. It is estimated that nurseries in F.R. Germany annually produce about ten million cactus plants. In addition, increased greenhouse heating costs in F.R. Germany are driving up production costs, leading to increased imports of cacti from Mediterannean countries (Menzel, in litt.).

According to Menzel (in litt.) the most commonly-available succulent species in F.R. Germany include Agave victoria-reginae (grown from seed in the Mediterranean region), Ceropegia debilis, Euphorbia obesa, E. caput-medusae, E. grandicornis, E. tirucalli, E. trigona, Pachypodium lamerei, P. geayi, and P. saundersii.

France

French CITES annual reports provide few data on trade in cacti and other succulents. In the most recent published report (1982), the only such transaction recorded is the reexport of 550 kg of Aloe species to Japan. More recent information on exports provided by the French Management Authority is given in Table 5. 1984 French statistics report the import of two Asclepiadaceae specimens from Thailand.

Information from annual reports of other CITES parties reveals relatively limited exports of cacti to France. For example, 1983 statistics record the export of 3,400 "Cactaceae" from Japan, 8 "Cactaceae" and 42 specimens of 24 named species from Canada. In contrast to F.R. Germany and Belgium, France does not have a strong tradition of collecting rare cacti from the wild.

Data on trade in other succulents in 1983 show some imports of Pachypodium, Aloe, and Euphorbia species from the U.S., and some people consider France the main

point for Madagascan succulents imported into Europe.

Production of cacti and other succulents in France tends to be concentrated around the Mediterranean coast. The Groupement National Syndicat des Producteurs de Cactees & Plantes Grasses compiled a list of 17 cactus producers based in this region. The nurseries have links with traders in Belgium, F.R Germany, and the Netherlands.

Greece

Greece is not yet a party to CITES but implements the provisions of the Convention through the EEC Regulation. Information is not yet available on Greek production or exports of either cacti or other CITES-listed succulents. CITES reports from exporting countries show a range of species exported to Greece in 1982 and 1983. The survey found no other information on Greek succulent plant trade.

Ireland

Ireland is not yet a party to CITES but implements the provisions of the Convention through the EEC Regulation. The 1982 CITES statistics of exporting countries show a very small number of CITES-listed succulents exported to Ireland. The survey found no other information on the Irish plant trade.

Italy

Italy is primarily considered a producer, rather than a major importer, of cacti and other succulents. However, one British specialist nursery named Italy as its main export market (Mottram, pers. comm.). Trade in CITES-listed cacti and other succulents is controlled on the basis of phytosanitary certificates for artificially-propagated plants and no statistical data have been collected by the CITES Management Authority (Vicentini, in litt.).

Luxembourg

Luxembourg has no nurseries producing cacti and other succulents and, according to the CITES Management Authority, does not trade in "wild-collected or protected plants" (Salentiny, in litt.). It is assumed that enthusiasts there purchase plants from nurseries in neighboring countries.

Netherlands

In the Netherlands CITES enforcement for plants started with the implementation of the EEC Regulation on 1 January 1984. The Netherlands has not yet published any detailed data on the trade in cacti and other succulents covered by CITES.

A paper presented by the Dutch Management Authority at the Fifth Meeting of the Conference of the Parties to CITES (Buenos Aires, 22 April-3 May 1985) gives the following estimated export figures for 1983:

Figure 1

Dutch exports of CITES-listed succulent plants	
Aloe spp. (Appendix II)	59,000
Cacti (Appendix II)	5,400,000
Ceropegia woodii (Appendix II)	630,000
Succulent *Euphorbia* spp.	620,000
Pachypodium lamerei	186,000
Total	6,895,000

These plants are listed in a booklet produced by the Flower Council of Holland illustrating the 379 most common pot plants produced by the Netherlands.

The Netherlands produces and trades in very large quantities of mixed non-specific artificially-propagated cacti. A single firm, Edelman, sells about 18 million of these plants per year, supplied in part by 26 small-scale Dutch growers. These plants are produced for the houseplant market and are of limited interest to serious cactus collectors. The same applies to other succulents produced in bulk and generally sold as unnamed specimens.

Artificially-propagated cacti and other succulents are also produced for traders in the Netherlands by growers in other countries, where production costs are cheaper or specialized production techniques have been developed. Wholesale exports of artificially-propagated plants by these countries are scarcely reflected in CITES statistics.

In addition to the general succulent plant trade, there are at least eight specialist nurseries providing both propagated and wild-collected material for specialist succulent plant collectors. Two nurseries well-known for selling wild-collected plants were visited during the survey. Both these nurseries appear to specialize in South American cacti, all of which are on CITES Appendix II. One of the firms appeared to sell wild-collected plants almost exclusively and gave the greatest cause for concern of all the nurseries visited during the survey. This firm advertises through all the major European specialist societies and has recently offered botanic gardens "very sought after landscaping dominating (sic) cacti from the Sonora desert." Although there are no restrictions on the sale of wild-collected specimens, imports obviously need to be carefully monitored.

The Dutch government scrutinizes CITES plant imports more closely than exports. For imports of CITES-listed plants outside the EEC, an import permit is

required from the Directorate of Nature, Environment & Fauna Management (Ministry of Agriculture and Fisheries), the principal CITES Management Authority. The permit is not usually given unless a copy of the export document is produced. Customs officers check the documents at the time of import. No permits are required, although the importer must prepare and submit an import certificate together with the export document (Anon., 1984).

For exports of the cacti and succulents included in Figure 1, a phytosanitary certificate with the declaration "Artificially propagated as defined by CITES" serves as a certificate of artificial propagation. Export controls for these plants are the responsibility of the Plant Protection Service.

Official enforcement of CITES controls on cacti and succulents is monitored by TRAFFIC(Netherlands) in conjunction with WSB (Werkgroep Succulenten Bescherming), an amateur group set up in 1981 to discourage the sale of wild-collected succulent plants. The group is currently carrying out a survey of Dutch nurseries with TRAFFIC(Netherlands).

Other European Countries

Austria

1983 CITES statistics show a range of cacti from Japan, U.S., and F.R. Germany exported to Austria. The largest transaction recorded is 23,700 cacti exported by Japan.

There are several specialist cactus and succulent plant nurseries in Austria known to sell wild-collected plants. Such plants have also been sold in small flower shops there, reputedly imported in mixed consignments of plant material via the Netherlands and Hamburg (Unger, in litt.).

Malta

Malta, which is not a CITES party, is cited as a major exporter of cacti to the U.K. (Jarvis, 1979). The supplier of these plants, R. Zahra, produces about 10,000 seedlings of 300 cacti and other succulent species each year. There are no commercial succulent plant nurseries in Malta and Mr. Zahra operates only on a part-time basis. Exports to the U.K. from Malta used to number about 5,000 plants per year but have fallen markedly, partly because of the lengthy import permit process in the U.K. (Zahra, in litt.).

Spain

Spanish growers have established large-scale commercial production of cacti and succulents over the past twenty years. By 1973, the production of cacti by

Spanish nurseries reached 1 million plants. In the same year, Spain imported one half million plants before increased domestic production caused imports to decline to "some thousands of plants coming occasionally from England, Holland, or Germany" (Ballester-Olmos, undated). Current estimates of cactus production are given in Figure 2.

Figure 2
Spanish production of cacti

Region	Number of major nurseries	Annual production
Valencia	3	4 million
Catalonia	4	2-3 million
Canaries	6	0.5 million
Majorca	3	0.3 million
South & Southwest		0.2-0.4 million
Total		7.0-8.2 million

Source: Ballester-Olmos, in litt.

Detailed data on the export of cacti and other succulents are not yet available as Spain only began implementing CITES upon joining the EEC at the beginning of 1986, although nursery visits in other countries confirmed that there is a substantial export of cacti from Spain.

In the Canary Islands cacti such as Echinocactus grusonii and Melocactus species are grown from seed outdoors. One firm (Casa Cactus, Tenerife) produced 600,000-700,000 plants in this way in 1983, mainly of Melocactus, Echinocereus, and Astrophytum. About 60 percent of the entire production of this nursery went to F.R. Germany, 30 percent to the Spanish market, and the rest to Austria, Belgium, Netherlands, and Switzerland (Broogh, 1983). Several Dutch and German cactus traders own nurseries in the Canary Islands, e.g. Beidel (Bisnaga, Steinfeld, F.R Germany), and Hovens (Nr. Lottum, the Netherlands), or have close links with nurseries based there, e.g. Kohres, (F.R. Germany).

The availability of mature outdoor-grown cacti on the European market may help to reduce demand for plants collected from the wild. Melocactus specimens with cephalia can, for example, be raised from seed in four years in the Canary Islands where production costs are considerably lower than in more northern climates. However, serious collectors have expressed serious doubts about Canary Island plants. They are concerned that species are no longer true to type as a result of hybridization. In addition, they are concerned about the quality of the

plants (de Herdt, pers. comm.). Subsequent growth of the plants upon import to northern Europe can be poor (Taylor, pers. comm.).

In addition to nursery-produced plants, the Canaries do have native succulents of interest to collectors. Wild-collected specimens of Euphorbia balsamifera, a species not uncommon in the wild, are currently offered by Dutch and German nurseries.

Switzerland

Information on the plant trade in Swiss CITES annual reports is extremely limited, although other countries do record a substantial export trade to Switzerland of rare species of cacti.

Switzerland only recently started to fully enforce CITES for plants. Enforcement is the responsibility of the Phytosanitary Service, which issues CITES permits and carries out border controls. According to Dollinger (in litt.), the Phytosanitary Service was reluctant to carry out CITES plant controls on a regular basis. Since September 1984, however, the Service has collected foreign CITES documents and, since February 1985, has fully implemented border controls (Dollinger, in litt.).

The reluctance of Switzerland to enforce CITES for plants resulted in reservations being placed on various CITES species. These have now been withdrawn.

The appointment of Mr. D. Supthut, Director of the Zurich City Succulent Collection (an important collection of the International Organization for the Study of Succulent Plants), to the CITES Scientific Authority further underscores Switzerland's positive attitude toward CITES plant controls. The Zurich Succulent Collection prepared a handbook on cacti and other succulents for enforcement officers and held a seminar for enforcement officers.

Switzerland has two main specialist succulent nurseries, including one known to trade rare species in apparent violation of CITES. This firm imported a consignment of wild-collected Backbergia militaris in 1984. Forty specimens were recently made available at a sale exhibition for $168 each. The Swiss Federal Customs stopped the sale and inspected the firm, which revealed other Appendix I species, i.e. Obregonia denegrii and Ariocarpus trigonus (Supthut, in litt.). An earlier visit to the nursery by an independent Swiss cactus expert in 1984 revealed wild-collected plants of Ariocarpus, Turbinicarpus, Thelocactus, Epithelantha micromeris, Astrophytum myriostigma, and A. ornatum on sale.

A recent inspection of the other main specialist nursery found some wild-collected CITES Appendix II plants for sale, together with artificially-propagated specimens grown by the nursery and imported from the Canary

Islands (Suphut, in litt.). The wild-collected plants from shipments imported three to four years ago included Copiapoa species (imported from Peru) and Echinocereus species (imported from Mexico).

Conclusions

This survey shows that there is still a market in Europe for rare wild-collected cacti and other succulent groups. For some species, artificially-propagated specimens provide collectors an acceptable alternative, no doubt in part because the specimens are less expensive and more likely to be healthy plants. For other species, particularly those that take a long time to assume a wild appearance when grown from seed, collectors may prefer wild plants.

Appendix I listing does seem to encourage artificial propagation by nurseries of the slow-growing rare species or the sale of seed from "mother" plants (often from the wild) directly to enthusiasts. Wild-collected Appendix I plants are, however, still available from a few specialist nurseries in Europe. The number of Appendix I plants seen in F.R. Germany suggests the occurrence of illegal importations after the Parties agreed to transfer certain cactus species to CITES Appendix I in 1981 and 1983.

The volume of trade in South American cacti causes concern. Brazilian species of Discocactus and Uebelmannia are commonly encountered in European trade as mature wild-collected plants, and wild-collected Copiapoa species from Chile (imported via Peru) are sold by a number European nurseries, although artificially-propagated specimens are readily available. As the EEC is a major consumer of certain South American cacti and thus poses a conservation threat, it would be appropriate to consider listing certain genera in Annex C2 of the EEC CITES Regulation (see recommendations below).

The "further measures" taken by the U.K. for cacti under Article 15 of the EEC Regulation should be reconsidered in line with this proposal. Stricter controls adopted by the U.K. have unfortunately caused confusion and resentment among British nurseries and collectors, particularly as the plants continue to be freely available elsewhere in the EEC. A common EEC stance on the relatively heavily-exploited species would be desirable.

The bulk of the European trade in cacti is in artificially-propagated specimens grown in Europe. The same is true for other succulents, although for these, imports from nurseries in the countries of origin probably form a more substantial proportion of the trade. It is sometimes difficult to determine whether artificially-propagated plants conform with the definition adopted by CITES (Resolution Conf. 2.12). The present survey reveals trade in wild-collected Madagascan and South African succulents not reflected in official statistics.

In Madagascar, there is only one nursery exporting succulent plants and

controls on personal collection are particularly strict, so there is a well-established basis for a legitimate export trade. However, doubts remain about the origin of plants exported by the nursery.

For CITES purposes it would be useful to have an index of major succulent plant nurseries, which indicates whether each trades exclusively in artificially-propagated plants. This would allow import licensing to take place with a greater degree of confidence that it is not legitimizing illicit trade in rare plants.

Nursery visits proved valuable during the survey, since they revealed a considerable amount of information not available from official sources nor readily apparent from nursery catalogues. Nurserymen contacted during the survey were generally cooperative and prepared to work for more effective controls when they believed it would benefit species in the wild. Unfortunately, several European nurseries do appear to operate completely outside conservation controls and cause a disproportionate amount of damage to wild populations.

Recommendations

1) Imports of CITES-listed plants into the EEC from their countries of origin should be monitored and reported effectively to species level.

2) An index of major EEC traders in cacti and other succulents should be prepared by the EEC with information on the main type of plants sold, including whether artificially-propagated CITES Appendix I plants are produced.

3) Each EEC state government should make clear to national traders the legislation affecting the sale of artificially-propagated specimens of CITES Appendix I plants in the EEC.

4) Stricter enforcement measures should be taken to prevent the sale of wild-collected Appendix I specimens in the EEC.

5) The following genera should be considered for Annex C2 listing under EEC Regulation 3626/82 for species not already listed in CITES Appendix I:

Genus	Country of origin
Ariocarpus spp.	Mexico, U.S.
Copiapoa spp.	Chile
Discocactus spp.	Brazil, Bolivia, Paraguay
Uebelmannia spp.	Brazil

6) Efforts should be made to encourage field surveys for the above genera to establish the current status of species in the wild.

7) The following species should be considered for addition to CITES Appendix II:

Taxon	Country of origin
Adenia spp.	South Africa
Fockea spp.	South Africa
Haworthia spp.	South Africa
Dioscorea elephantipes	South Africa
Nolina (including *Beaucarnia* spp.)	Mexico, U.S.

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Table 1

CITES succulent plants (excluding cacti and Aloe ferox) exported from South Africa to Europe in 1982 and 1983

Scientific name	Importing country	1983	1982
Aloe spp.	U.K.		500
A. andongensis	Italy	1 (ap)	
A. bainesii	F.R. Germany	2 (ap)	
A. bakeri	Italy	1 (ap)	
A. bowiea	F.R Germany	1 (ap)	1 (ap)
	Switzerland		3 (ap)
A. dichotoma	F.R Germany	1 (ap)	
	Italy	1 (ap)	
A. haworthioides	F.R. Germany	5 (ap)	
	Italy	1 (ap)	
	Switzerland	1 (ap)	
A. jacksonii	Italy		1 (ap)
A. plicatilis	F.R. Germany	2 (ap)	
	Italy	1 (ap)	
A. ramosissima	F.R. Germany	1 (ap)	
	Italy	1 (ap)	
A. saponaria	Switzerland	1 (ap)	
A. ustulata	Switzerland		3 (ap)
Anacampseros filamentosa	Italy	1 (ap)	
A. papyracea	Italy	2 (ap)	
	U.K.	10 (ap)	10 (ap)
A. telephiastrum	U.K.	10 (ap)	
A. ustulata	U.K.		10 (ap)
Ceropegia spp.	U.K.		750
Euphorbia spp.	U.K.	335	1,630
		13 (ap)	
Pachypodium spp.	U.K.	60	5
P. lamerei	U.K.		5 (ap)
P. succulentum	France		1 (ap)
	F.R. Germany	10 (ap)	1 (ap)
	Italy		1 (ap)
	U.K.		10 (ap)

Source: CITES annual reports
ap=artificially propagated

Table 2

Exports of non-CITES succulents from Transvaal to Europe in 1984

Scientific name	Family	Quantity
Adenia glauca	Passifloraceae	10
Cotyledon luteosquamata	Crassulaceae	5
C. paniculata	"	60
C. reticulata	"	10
C. wallichii	"	10
Fockea edulis	Asclepiadaceae	5
F. ferox	"	5
F. inermis	"	10
F. tugelensis	"	20
Nananthus transvaalensis	Mesembryanthemaceae	600
Pterodiscus aurantiacus	Pedaliaceae	60

Source: du Plessis (*in litt.*)

Table 3

Danish production of CITES succulents

Scientific name	No. of nurseries	Approximate annual production
Agave victoria-reginae		little production
Aloe spp.	10	100,000
Cactaceae (mainly *Schlumbergera*)	20	15,000,000
Ceropegia woodii	10	100,000
Euphorbia millii & *trigona*	10	1,000,000
Euphorbia (other succulent spp.)		little production
Lewisia cotyledon		little production
Pachypodium lamerei	20	400,000
Pachypodium namaquanum		little production

Source: Government Plant Protection Service (Mikkelsen, *in litt.*)

Table 4

Sales of succulent plants in F.R Germany

Type of plant	Annual sales (millions)
Cacti	15-20
Pachypodium	1
Euphorbia millii & hybrids	>1
other succulents	1-2

Source: Menzel, *in litt.*

Table 5

Exports of cacti and other succulents by France

Scientific name CITES plants	Quantity 1984	 1985 (Jan-Mar)
Agave victoriae-reginae	501	
Aloe spp.		210
Aloe hybrids	1,008	
Euphorbia spp.	2,554	10,642
E. aeruginosa	4,485	
E. herythera	692	
E. polyantha	2,079	
Pachypodium spp.	510	4,084
Astrophytum ornatum	40	
Azureocereus spp.	40	
Cereus spp.	1,260	6,710
C. forbesi	40	
C. 'vert'	40	
Coryphantha erecta	40	
Echinocactus grusonii	40	
Ferocactus spp.		28
Espostoa lanata	40	
Hertrichocereus beneckei	40	
Lemaireocereus dumortieri	40	
Machaerocereus (Stenocereus?) thurberi	40	
Mammillaria spp.		2,250
M. candida	40	
M. rhodantha	40	
M. spinosissima	40	
Notocactus magnificus	40	
Opuntia spp.	960	16,527
O. basilaris	2,000	
O. mayavensis	4,664	
O. monacantha	96	
O. microdasys	480	
O. tunicata	11,826	
Pachycereus pringlei	60	
Pilosocereus chrysacanthus	40	
Selenicereus grandiflorus	1,386	
Trichocereus schickendantzii	40	
Weberbauerocereus winterianus	40	

Table 5

Exports of cacti and other succulents by France

Scientific name	Quantity	
	1984	1985 (Jan-Mar)
Non-CITES Plants		
Aeonium spp.		100
Agave spp.		36
Conophytum spp.	945	
Cotyledon spp.		2,433
Crassula spp.		441
Echeveria spp.		2,560
E. pulvinata	1,840	
Kalanchoe spp.	3,168	19,400
Lithops spp.	5,040	
Mesembryanthemum spp.		222
Nolina spp.		60
Stapelia spp.	1,056	3,411

Source: French Management Authority (Maler, *in litt.*)

Annex 1

Alternatives for names, used in tables, which are generally considered to be synonyms

Table No.	Name used	Alternative name
	Cacti:	
5	*Hertrichocereus beneckei*	*Stenocereus beneckei*
5	*Lemaireocereus dumortieri*	*Stenocereus dumortieri*
5	*Machaeocereus thurberi*	*Stenocereus thurberi*
	Opuntia mayavensis	?
5	*Opuntia monacantha*	*Opuntia vulgaris*
5	*Pilosocereus chrysacanthus*	*Cephalocereus chrysacanthus*
	Other succulents:	
1	*Anacampseros ustulata*	?
5	*Euphorbia herythera*	?

? denotes that the species to which this name refers is unknown

The Japanese Trade in Cacti

Tom Milliken, Kazuko Yokoi, and Shinobu Matsumura*

Introduction

The cactus family, Cactaceae, is widely distributed in the New World extending from the Canadian border in North America through Central America, the West Indies and South America. Only a few cactus species from the genus Rhipsalis are found outside of the Americas, two endemic to Madagascar and others distributed in Sri Lanka, Seychelles, Mauritius, and southern Africa. In addition, many Opuntia species have naturalized around the world.

Fascination with many of the family's more than 2,000 species has resulted in large-scale international trade to meet the demands of cactus collectors throughout the world. While artificially-propagated plants account for much of the current trade, collection of specimens from the wild continues, often to the detriment of affected species.

The status of most cactus species in the wild remains unknown, but a growing body of evidence strongly suggests that the situation is serious for much of the family. For example, a recent study by the Threatened Plant Unit (TPU) of the International Union for Conservation of Nature and Natural Resources (IUCN) revealed that one-third of the over 600 endemic species in Mexico "are under threat or not well enough known in the wild for a conservation category to be assigned" (Oldfield, 1984). Unprecedented private and commercial collection of Chile's 200 cactus species -- 180 of which are endemic — is believed to be responsible for the extinction of some species in recent years (Hoffmann, pers. comm.). Only 19 out of 112 taxa endemic to the Carribbean islands are not threatened with extinction (Oldfield, 1984). Regardless of the location, for most species, over-harvesting for commercial trade is the primary threat; habitat destruction remains a secondary consideration.

While many countries have enacted national laws to protect native cacti from commercial exploitation, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) provides the only international basis for controlling trade. Since July 1, 1975 all cactus species have been listed on the CITES appendices, with the exception of Rhipsalis species and parts and derivatives of Opuntia species outside the New World. Appendix II specimens must have valid CITES export or reexport permits to be legally traded. More stringent protection is given to two cactus genera and 34 species listed on Appendix I of CITES, which prohibits, except under special circumstances, all international trade in plants collected from their native habitats.

*The authors' address is TRAFFIC(Japan), 39 Mori Building, 2-4-5 Azabudai, Minato-Ku, Tokyo 106, Japan.

Cacti have enjoyed popularity in the Japanese plant trade for several decades. Many cactus species are cultivated on a large scale for export and domestic consumption by Japanese growers renowned for their perfection of advanced propagation methods. The development of sophisticated seed germination, tissue culture, and grafting techniques has made Japan a welcomed world leader as a cactus cultivator. At the same time, Japan remains one of the major importers of wild-collected cacti, including many endangered Appendix I and other rare species. Despite CITES controls, the Japanese market presents a serious problem for the conservation of cacti.

To date, the Japanese cactus trade has not been surveyed in any detail. This study presents the first comprehensive look at the continuing trade in species protected from commercial exploitation under CITES and the U.S. Endangered Species Act (ESA), along with data compiled on other trade in wild-collected species. This report also assesses the implementation of CITES for Japan's trade in cacti, and recommends ways to improve plant controls in Japan.

History of the Japanese Trade in Cacti

Cacti were first introduced to Japan about 300 years ago. The first cactus imported to Japan, probably Opuntia maxima, was described in Wajiga by Kokichi Kaibara in 1688 (Yuasa, 1972). Large-scale importation of cacti began two centuries later, in 1895, when the Shokeien Company took advantage of the recently completed trans-Siberian railway to pioneer trade with nursery dealers in Germany, Belgium, the Netherlands, and England. The first recorded instance of direct trade with a country having native Cactaceae occurred a year later, with Mexico (Ariga, 1977). Thereafter, interest in the cultivation of cacti steadily expanded and by 1930 Japanese nurseries were exporting propagated specimens to Europe and the United States. This period was characterized as a "Golden Era" for the industry and lasted until the outbreak of World War II, which brought a temporary halt to the trade (Ariga, 1977).

In the post-war period, commercial interest in cacti vigorously rebounded. Importation soon resumed and large quantities of cacti were brought in from Europe and other producer countries. At the same time, the development of a novel propagation technique for seeds, known as the Aichi Method, enabled Japanese nurseries to cultivate cacti on an unprecedented scale. By 1955, Japan was again one of the world's biggest importers and exporters of cacti. In addition to the large-scale production of cacti by commercial nurseries, many collectors and amateur propagators cultivated cacti hoping to realize profits on homegrown plants. Their results, however, were not always satisfying and the production of new varieties by random crossings resulted in many poor quality specimens of low commercial value. Because of these problems and other cultivation difficulties, the "cactus fever" that spurred this second "Golden Era" gradually declined after 1965 (Ariga, 1977).

Now, some observers claim, fewer species of wild-collected cacti are imported to Japan and only nurseryowners cultivate cacti for commercial export (Ariga, 1977). Nonetheless, Japan still remains central to the international cactus trade, both as a major importer and exporter. Between 500 to 1,000 taxa (including species, subspecies, and varieties) are believed to be regularly cultivated in Japan. It is not unusual for cactus collectors to maintain 1,000 taxa in a home collection; serious connoisseurs are said to keep over 1,500 different varieties (Hirao, 1980).

Classification of Cacti

Unfortunately, taxonomic and nomenclature problems plague the Cactaceae. Depending on the source, between 21 and 300 genera and 800 to more than 2,000 species are recognized. A checklist of cactus genera prepared for the CITES Special Working Session in 1977 listed 236 genera. The U.S. government produced a checklist of preferred cactus names in 1981 (McMahan, 1981) in an attempt to make Cactaceae more manageable for CITES implementation purposes. (This list is now being revised.) Since then, another more recent and streamlined compilation by the IUCN Wildlife Trade Monitoring Unit (WIMU) identifies 130 genera and about 1,875 species. The WIMU compilation is used for processing CITES annual report data.

Nomenclature problems are no less acute in Japan. A history of intensive cultivation, the development of a great number of hybrids, and an ingrained cultural penchant to assign different names to specimens which are slightly different in shape, size, or color, has resulted in a proliferation of cactus taxa, some of which seem to be known only by their Japanese common names. One expert claims that some 2,000 taxa (including some which were not successfully maintained in cultivation and no longer exist in Japan) have been imported and, when combined with the great number of hybrids which have originated in Japan, the number of known cactus varieties totals 3,000 (Hirao, 1980). Other writers on the subject in Japan believe the Cactaceae number around 2,500 species (Morita, 1983).

As a general rule, Japanese classification of cacti is based on Cactus Lexicon by Curt Backeberg (1976) with descriptions of newer species by Walter Haage, although there are many exceptions to this. In practice, Japanese growers and collectors commonly use Japanese names, instead of scientific names, when referring to their plants. This causes considerable difficulty for accurate trade data analysis.

In this report, trade data have been analyzed largely according to the systematics used by WIMU, with Plants Protected by the Convention on International Trade in Endangered Species of Fauna and Flora, A List of Plants Reported in Trade, Including Common Names and Synonyms (McMahan, 1981) as a secondary reference.

Methodology

Catalogue Survey Data

Many Japanese dealers specializing in cacti and other succulents openly promote their trade through the periodic circulation of sales catalogues. The quality of the information in the catalogues varies to some extent, but generally all species are identified by Japanese common name, size, and price. Imported wild-collected plants are usually distinguished from artificially-propagated specimens. Some catalogues also give scientific names, countries of origin, and information on availability and some even feature photographs of each individual plant offered for sale.

For this study, two catalogue surveys were conducted. In the first, data were compiled from 25 sales catalogues issued between January 1982 and March 1984 by 10 major Japanese cactus dealers. These importers and growers are all located on the main Japanese island, Honshu, between Fukushima and Okayama. The catalogues were analyzed to identify trade in CITES Appendix I species, taxa protected from commercial export under the ESA, and other wild-collected North American cacti. When not specified, size and price were used to differentiate wild-collected plants from cultivated ones.

Trade in South American species was the major focus of a second survey of nine sales catalogues from seven companies issued between January 1985 and March 1986. Data were also collected on wild-collected North American species not previously identified in the earlier survey.

CITES Annual Report Data

A second source of information used in this study was a compilation of all cactus transactions involving Japan contained in CITES annual reports from 1980 through 1984. Provided by WIMU, these data were reviewed to identify species, trade routes, and other information relevant to the Japanese trade.

Unfortunately, the CITES data are largely incomplete for this period. The Japanese CITES annual reports only identify trade in cacti as "Cactaceae spp." for these years. While this sheds some light on overall trade volumes and patterns, it voids any proper analysis of the data at the species level. Actual trade volumes cannot be determined as the units for quantity are inconsistent in the Japanese data; number of plants, number of cartons, and weight are all used interchangeably.

The only data at the species or genus level come from the U.S. reports. Since U.S. exports and reexports of cacti comprise a significant portion of the Japanese trade, a more detailed picture emerges. However, other problems with the data inhibit interpretation. Both the U.S. and Japanese reports occasionally

distinguish "artificially propagated" trade in the data, but, as other writers have pointed out, caution needs to be exercized in accepting this at face value, particularly where reexports of Mexican cacti are concerned (Fuller, 1985b). At the time of this writing, no data were available at all for many suppliers of cacti to Japan, particularly the Netherlands, Denmark, and F.R. Germany.

Market Survey Data

Finally, a market survey was undertaken with a TRAFFIC researcher visiting seven major importers or retailers. Through interviews and observations further information on species in trade, importation routes, mortality, and the pricing of cacti in Japan was obtained. In all instances, none of the cactus dealers interviewed were aware of the fact that they were providing information for a TRAFFIC report. This was necessary in order to obtain information that would not be otherwise forthcoming.

Results and Discussion

Trade Routes and Volumes

North America

Traditionally, the U.S. has played the major role in moving Mexican cacti to Japan. According to CITES data, both the U.S. and Mexico remained regular sources for cacti from 1981 through 1984, but trade was erratic, which probably reflected the general uncertainty over the legal status of Mexico's trade with the United States. In the U.S. CITES annual report data, trade to Japan fluctuated from a high of about 23,000 plants in 1981 to a low of about 6,000 in 1984, but the percentage of reexports of Mexican cacti accounted for between 76-94 percent of this trade (Table 2). Japanese data, though much less complete, generally show a similar level of trade from the U.S. (Table 1).

Recent U.S. action to curtail the reexportation of Mexican cacti is based upon a 1940 Presidential Decree in Mexico, which generally prohibits commercial collection of wild cacti and orchids. These moves have caused Japanese dealers to search for new trade routes. In the CITES data, direct importation from Mexico to Japan seemed to increase considerably in 1983, when agitation was mounting in the U.S. over the legality of Mexican imports. The same year, imports from Mexico even included the reexport of 4,700 cacti of U.S. origin, a clear reversal of the traditional trade pattern (Table 2).

In 1984, however, both direct trade from Mexico and the U.S. dropped considerably (Table 2), again reflecting the changing situation in the United States. Continuous commentary published in the sales catalogues of the Japan Cactus Planning Co., Ltd. highlighted these developments. The March 10, 1984 price list claimed that 175 Ariocarpus retusus, 55 Astrophytum myriostigma, 20 A. myriostigma var. coahuilense, and 16 Lophophora williamsii, all listed with photos,

were transported to the U.S. before February 5, 1984 and that it would be hard to obtain them in the future.

The June 21, 1984 price list, which featured 40 Ariocarpus fissuratus, 107 Ariocarpus retusus, 64 Astrophytum myriostigma, and 41 Lophophora williamsii, signaled the end of the trade:

> The last North American cacti have arrived. The U.S. exporters have told us that it will be impossible to send cacti through the regular channels. We are sorry about this situation. In spite of our efforts to find another channel, we have not yet succeeded. If the prohibition of cactus trade continues, wild-collected cacti will be incredibly valuable in Japan. Please take good care of your collection.

The scramble for new routes apparently met with some success. A January 25, 1985 catalogue indicated that a way to import from Mexico had been found, but cautioned that trade would not be stable:

> We have got good news for the New Years. Wild-collected specimens are going to be imported little by little. There was no hope to import wild-collected specimens last year. We will import them through a new channel. Although the new channel is not stable and it can be stopped at any moment, we will do our best to offer wild-collected specimens to you as long as they are available.

While perhaps these statements were exaggerated ploys to get people to buy more cacti, they did, in fact, reflect a changing and uncertain situation. Japanese dealers were clearly searching for new channels to import wild-collected North American cacti. Analysis of the catalogues indicated that prices for wild-collected specimens gradually increased during this time.

Some dealers have suggested that illegal importation of Appendix I species through the U.S. has continued, but without the 'come-on' publicity noted in the catalogue extractions above. Small-sized Aztekium ritteri, Obregonia denegrii, Strombocactus disciformis, and Pelecyphora species were alleged to have been imported together with particularly thorny propagated cactus species from California, wrapped in newspapers. Custom officers at Narita Airport, who apparently dislike handling thorny species, allowed the shipment to pass after examining only a few samples of Appendix II species selected by the importers themselves.

South America

Direct South American routes remain largely undeveloped with only occasional trade from Peru, Chile, and, most recently, Colombia reported in the data (Table 3). Reports of Japanese fishing vessels plying Chilean coastal ports to obtain cacti for transport back to Japan remain largely unsubstantiated.

Most South American cacti are believed to come to Japan through intermediary countries in Europe, particularly the Netherlands and F.R. Germany. Very limited trade through the U.S. has also been recorded in the CITES data.

Europe

In the CITES data Japanese imports of cacti from Europe center primarily upon the Netherlands and Denmark, with occasional small shipments reported from both the German Democratic Republic and F.R. Germany. While the Netherlands and Denmark accounted for some 125,000 cacti in 1981, the trade had dropped to under 10,000 plants by 1984 (Table 3). Both countries propagate cacti on a large scale and only the Netherlands is known to trade in wild-collected specimens to any extent (Oldfield, 1985). While the earlier trade was undoubtedly comprised primarily of artificially-propagated stock, more recent trade is known to have contained wild-collected plants.

Japanese importers reported that F.R. Germany was the source of many South American species, particularly Peruvian and Chilean cacti. Stories of German immigrants supplying Copiapoa species to F.R. Germany for export to Japan were mentioned on a number of occasions during visits to Japanese importers and retailers.

The Dutch connection seems to be especially important in the trade of Mexican and South American wild-collected cacti, including Appendix I species. For example, in late February 1986 one large shipment from the Netherlands included at least 300 Ariocarpus trigonus and approximately 100 Pelecyphora plants, all Appendix I species. While the Ariocarpus were possibly brought from Mexico by the Japanese importer, the Pelecyphora spp. had been cultivated in the Netherlands for about two years after being obtained from Mexico. Other cacti in the same shipment included several Discocactus and Uebelmannia species, Borzicactus celsianus, Echinocactus horizonthalonius, Thelocactus hexaedrophorus var. fossulatus, T. macdowellii, and Ferocactus peninsulae. These plants were believed to have been identified in the Dutch export documents as "artificially propagated" stock (van der Plas-Haarsma, pers. comm.). Oldfield (1985) also found a variety of wild-collected South American cacti at two Dutch nurseries she visited, one of which is now known to have exported the above shipment.

Asia

China unexpectedly appeared in Japan's 1982 CITES annual report data as the single largest supplier of cacti — including some 80,000 plants — although the Chinese CITES annual report does not list any exports of cacti (Table 3). China is not known to propagate cacti for export. Since 1982 there have been no imports attributed to China in the Japanese data. China was most likely misidentified as Taiwan, which exported small quantities of cacti to Japan in 1983 and 1984 (Table 3). This trade is believed to involve cultivated stock, although further investigation is needed.

Importers and the Sale of Cacti

Currently there are only three major importers of wild-collected cacti in Japan, although others, on occasion, engage in importation. Of the major dealers, two are located in the Osaka area, Yamashiro Trading Company and Osaka Exotic Shokubutsu Kenkyu Kai, and the other, Takeo Cactus Garden, is situated near Tokyo. When the international trade in cacti remained unaffected by CITES or other domestic laws and U.S. trade routes were flourishing for Mexican species, Osaka dealers claimed over one thousand wild-collected plants would be imported in a single shipment several times a year. Another dealer claimed that shipments containing 10 metric tons of cacti were not unusual at one time, but that more recent shipments rarely contained more than a one metric ton of cacti.

Private collectors are very important consumers for the Osaka dealers. They are said to purchase about 50 percent of the cacti in any given shipment at special all-night auctions convened shortly after they clear Customs. Up to 100 collectors, mostly people in their forties who became dedicated cactus cultivators in their teens, assemble from all over Japan for the auctions. Collectors in turn, cultivate their wild-collected plants and organize cactus shows, where buying and selling of prize specimens is a regular activity to help augment the expenses of assembling and maintaining large collections of cacti. Some collectors reportedly earn greater profits than importers through these events. The remaining cactus stocks imported by Osaka dealers are sold to retail outlets or advertised in catalogues for general consumption.

The Tokyo-area dealer, who claims to trade in about 70 percent of the imported cacti, is largely a wholesaler, supplying retail nurseries throughout Japan. Only a very limited number of collectors purchase cacti directly from this importer. Cacti are quickly sorted, priced, and sent to retailers within a couple of days of clearing Customs. In addition to using U.S., Dutch, and possibly F.R. German dealers as intermediaries, this importer is also known to collect cacti directly in Mexico, apparently employing local people to scour the areas around their villages. It is clear that imports of wild-collected cacti from this dealer featured prominently in the catalogue survey.

Although cacti are rarely in demand for landscaping in Japan, the construction of botanical gardens can temporarily bring other companies into the cactus importing business. The Himeyuri Park, which opened in Okinawa in 1983, was landscaped with wild-collected cacti from Mexico by the Iwasaki Sangyo Co. That company is reported to have obtained a ship in Mexico, filled it with cactus and sailed it back to Japan. In the course of their flagrant violation of Mexican law, employees of Iwasaki Sangyo were arrested in Mexico with a trailer load of cacti. These individuals, who were posing as scientists, had in their possession

quantities of cacti far in excess of what their collecting permits allowed. The event received much publicity in the Mexican media, although it is evident that the shipload of cacti ultimately made it back to Japan.

Mortality and Pricing of Cacti in Japan

The pricing of imported cacti depends on several factors, including mortality during transport and rooting, the availability of species, and any unusual features that individual plants might have. Although precise mortality data are not available, Table 4 gives an assessment of the relative ability of cactus species or genera to withstand transportation and rooting. Another importer estimated that 30 percent of his imports die during transport and another 10 percent fail to take root upon reaching Japan.

Ariocarpus fissuratus, for example, reportedly suffer a high mortality during transport, but are considered to be fairly easy to root if they reach Japan in reasonable condition. On the other hand, Copiapoa species are generally hardy enough to survive the trip to Japan but are difficult to root thereafter. Generally, it is claimed that low altitude species grow fairly well in Japan, but that South American species from high altitude habitats are difficult to maintain in cultivation as their roots tend to wither during hot summer nights, possibly as a result of their crassulacean acid metabolism.

The Japanese climate, ranging in annual extremes from a snowy winter to a humid rainy season and hot summer, detrimentally affects plants during transport in a number of ways. Therefore, the timing of importation is particularly important and usually occurs from fall through spring but halts when the rainy season begins in late May through the hot summer months to September. One dealer claimed that more than 50 percent of imported cacti die due to high temperature and humidity if they arrive in Japan between June and August. Importation is concentrated in the winter months when the plants are naturally in a dormant stage. Even so, weather can still wreak havoc; one large shipment of cactus, which was estimated by the importer to value 10 million yen (one U.S. dollar approximately equalled 213 yen during the first catalogue survey), perished when importation happened to coincide with unusual subzero temperatures.

For plants that survive importation, weather continues to be an important factor in their development. Over time, changes in the general color of the plant or the size and color of the spines, particularly in Ferocactus, Eriosyce, and Echinocactus species, can be attributed to the effects of weather. For some species, the spines drop off altogether. The crown of Copiapoa species tends to bulge irregularly after continued exposure to excessive humidity and lack of sunlight.

Because of these changes in appearance, the value of wild-collected cacti drops considerably within three years of importation, so there is a constant demand

by collectors for new specimens. One dealer suggested that about 30 percent of the cacti he sells only survive two or three years. Sclerocactus and Pediocactus species were cited as not likely to last more than a year or so, even if they successfully take root. They are usually only maintained for any length of time through grafting.

While there is no fixed formula, hard to obtain slow-growing species that are difficult to transport or root, generally fetch the highest prices. Astrophytum asterias, Echinocactus polycephalus, and Aztekium ritteri, for example, apparently experience a high mortality during transportation and the rooting process, and consequently are expensive on the Japanese market. Fasciated or crested specimens are the most expensive plants on the market catering to the Japanese fascination for the bizarre and unusual. Regardless of species, special collector demand for such specimens far outpaces supply. Large clumps or colonies of Lophophora and other colonial species are also popular in the collectors' trade.

Implementation of CITES controls on the cactus trade and tightened export restrictions in the producer countries have definitely caused prices for most wild-collected cacti to rise. With future imports of certain species becoming increasingly difficult to guarantee, each shipment seems to take on a special importance which is reflected with rising prices.

Japanese Customs and Seizures of Cacti

While customs officers are charged with implementing CITES for plants, it is clear they lack even the most basic identification tools necessary for adequate control of the trade. Plant quarantine inspectors spend considerably more time with cacti than do customs officials, who inevitably rely on the importers themselves or the accompanying documents for determining the species composition of cactus shipments. Unfortunately, there seems to be little coordination between customs and plant quarantine inspectors, who in fact may be in a better position to accurately identify species. While certainly many opportunities have existed, to date only one seizure of cacti has occurred. In July 1985 three plants, apparently reexports from Israel without any CITES documents, were taken from an individual working for an Osaka-based importer. It is not clear which species these plants represented.

Species Found on the Japanese Market

CITES Appendix I Species

In the first catalogue survey, out of 25 catalogues representing 10 different dealers analyzed, 21 featured trade in Appendix I species either as seeds, artificially-propagated specimens, or wild-collected plants. A total of 27 out of 40 cactus species listed on Appendix I of CITES were identified for sale in Japan

(Table 5). Trade in 20 of these species included wild-collected plants and probably occurred in violation of CITES controls. Species most commonly traded included the three Ariocarpus species, Leuchtenbergia principis, Obregonia denegrii, Pelecyphora strobiliformis, Strombocactus disciformis, Turbinicarpus pseudomacrochele, and T. schmiedickeanus.

CITES annual report data from 1980 through 1984 revealed that a total of 16 Appendix I species were imported from the U.S. into Japan, all of which were species also identifed in the catalogue survey. Other imports, reported in the CITES data only at the genus level, could have masked trade in other Appendix I species. Most plants were reexports originating from Mexico, and trade in 12 species included specimens that were reported to have been artificially propagated there. (For a more detailed discussion see Genera Identified in the Japanese Trade below.)

U.S. Endangered Species Act Taxa

Six of the Appendix I species listed in Table 5 are also protected under the ESA. Possibly two other U.S. species, not listed on CITES Appendix I but protected from commercial exploitation under the ESA, were found in the first catalogue survey. Trade in Echinocereus reichenbachii var. albertii and E. triglochidatus were found, but the variety of the latter was not identified (Table 6). (For a more detailed discussion see Genera Identified in the Japanese Trade below).

Trade in Wild-Collected North American Appendix II Species

A large number of other wild-collected North American cacti are part of the Japanese import trade. The first catalogue survey revealed wild-collected trade in at least 81 species from 21 genera (Table 7). The later survey identified 10 more species and 3 new genera.

Four genera in particular, Ariocarpus (species not listed on Appendix I), Astrophytum, Epithelantha, and Lophophora, were the object of very high volume trades, as well as the species Echinocactus horizonthalonius, E. platycanthus, Ferocactus wislizenii, Homalocephala texensis, Mammillaria formosa, Thelocactus hexaedrophorus, and T. rinconensis (Table 7). (For a more detailed discussion see Genera Identified in the Japanese Trade below.)

Trade in Wild-Collected South American Species

Although the first catalogue survey did not involve South American species, a later effort identified trade in at least 40 species from 10 genera. Out of seven dealers surveyed between January 1985 and March 1986, six offered South American species. Most common in the trade were species from the genera Copiapoa, Discocactus, and Uebelmannia (Table 8). (For a more detailed discussion see Genera

Identified in the Japanese Trade below.)

Cactus Genera Identified in the Japanese Trade

Ancistrocactus

Of the two species in this genus, only limited trade in the more common one, Ancistrocactus scheeri, was found in the Japanese trade (Table 7). In 1982, the U.S. reexported 40 plants of Mexican origin to Japan, according to CITES data. There was no evidence of trade in the Appendix I species, A. tobuschii.

Ariocarpus

Three of the six slow-growing species in this genus of "living rocks" have been placed on CITES Appendix I, Ariocarpus agavoides, A. scapharostrus, and A. trigonus. Nonetheless, abundant trade continues in Japan for these and the Appendix II species.

Usually identified in the Japanese trade by its synonym Neogomesia agavoides when the scientific name is given, A. agavoides has a very limited distribution in northern Mexico. Listed as "Endangered" by IUCN due to excessive collecting, A. agavoides was moved to Appendix I of CITES in 1981. Offered by nine of the ten businesses surveyed, A. agavoides was one of the most common Appendix I species found in trade. A limited trade in seeds and small-sized artificially-propagated plants exists, but virtually all specimens larger than 2.5 cm were wild-collected plants. These comprised the bulk of the trade. Prices for wild-collected plants, while generally low when compared to other imported Appendix I species, were still four to eight three times greater than artificially-propagated specimens (Table 5). CITES data record 400 cultivated specimens imported from the U.S. in 1981.

A. scapharostrus, also regarded as "Endangered" by IUCN, was transferred to Appendix I of CITES in 1981. A. scapharostrus was common in the Japanese trade, most frequently occurring as wild-collected plants. Large-size specimens were offered for prices reaching 12,000 yen. A much more limited trade in seeds and small-size cultivated plants was also found (Table 5). 1981 CITES data record that 25 artificially-propagated specimens from Mexico were reexported to Japan by the United States.

Only known from a few localities in Mexico and classified as "Vulnerable" by IUCN, A. trigonus is heavily traded. This species was listed on Appendix I of CITES in 1983. Although a very common species in the Japanese trade, few cultivated specimens were found in the survey. Cultivated plants rarely reach 13 cm across (Chapman and Martin, 1982); in Japan the largest specimen found in trade measured 8 cm and was priced at only 1,000 yen. On the other hand, there is an abundance of trade in large wild-collected plants measuring between 16 to 24 cm and

ranging in price from 6,000 to 15,000 yen. One exceptional specimen, measuring 31 cm with five offshoots, was priced at 30,000 yen (Table 5). CITES data indicate that a minimum of 627 A. trigonus originating from Mexico were reexported by the U.S. to Japan, some as recently as 1983. In February of 1986, 300 specimens are believed to have been imported via the Netherlands.

In addition to the three Appendix I Ariocarpus species, the three other species which comprise the genus were also found to be heavily traded in Japan. Two species, A. kotschoubeyanus and A. retusus are Mexican endemics, while the other one, A. fissuratus, is distributed in both Mexico and the United States. All are listed as "Vulnerable" by IUCN. Of the hundreds of Ariocarpus plants available, A. retusus was the most abundant and included many fasciated specimens or plant clumps at exceptional prices reaching up to 185,000 yen. Trade in A. fissuratus also included entire plant clumps and one apparently very special plant measuring 11.5 cm was priced at 300,000 yen. Also relatively common, wild-collected A. kotschoubeyanus plants, with the exception of a few very large specimens, were comparatively inexpensive, averaging only 3,000-4,000 yen apiece. A limited trade in very small cultivated plants was noted for all species, but it seemed almost insignificant compared to the widespread availability of wild-collected plants. Seeds of A. retusus and A. kotschoubeyanus were also available (Table 7).

CITES data further reflect this high-volume trade. From 1981 through 1984, almost 20,000 plants were imported from the U.S. alone, involving annual trade in all three Appendix II species. The trade included over 11,000 A. retusus, 6,100 A. fissuratus, and almost 2,600 A. kotschoubeyanus plants. Other exports identified in the U.S. data as "Ariocarpus spp." and direct importation from Mexico (none of which was identified at the species level in the Japanese data) certainly included additional trade in all species.

Japanese collection tours to Mexico have also focused on Ariocarpus species. In Garden Life magazine, one trip billed as a "visit to the home of Ariocarpus," advertised for early 1984, included a map of the tour course which clearly identified collecting areas for four Ariocarpus species, including the Appendix I A. trigonus. The cost of the tour was advertised for 1,000,000 yen, but is unclear whether it actually took place (Takeo, 1983).

Astrophytum

Although all species in this unusual genus are easily cultivated, wild-collected specimens of three of the four species were abundant in the Japanese trade. A huge trade exists in wild-collected A. myriostigma, which is regarded as "Vulnerable" by IUCN. A. myriostigma var. coahuilense was the most abundant variety in the trade. Fasciated plants of this species were available and expensively priced, from 40,000 yen all the way up to an astonishing 330,000 yen. Two more Astrophytum regarded as "Vulnerable" by IUCN, A. asterias and A.

capricorne, including the variety senile, were also numerous, although the latter species lacked the considerable price range of the other two (Table 7). A. capricorne and A. myriostigma were also available as cultivated plants.

Trade in over 9,000 Astrophytum plants was reported in the CITES data. Although A. asterias was less frequently found in the catalogue survey than other Astrophytum species, it was the most commonly imported species in the CITES data, totalling 5,880 plants. Although only 615 A. myriostigma, 290 A. capricorne, and one artificially-propagated A. ornatum, a species not found in the catalogue survey of wild-collected plants, were identified, some of the 2,270 plants listed as "Astrophytum spp." probably involved additional imports of these species.

Trade in A. asterias is particularly worrying as many authorities believe this species is severly endangered and should be considered for inclusion on Appendix I of CITES (Sanchez-Mejorada, 1982; Campbell, 1986). Furthermore, trade in wild-collected plants is known to involve high mortality during both transportation and rooting (Table 4).

Aztekium

Endemic to Mexico, Aztekium ritteri is the only species in its genus. Difficult to cultivate from seeds (Oldfield, 1985; Rayzer, 1984), over-collection of this slow-growing species has greatly affected wild populations, now regarded as "Endangered" by IUCN. A. ritteri was listed on CITES Appendix I in 1981. Plants reported as cultivated were found in the Japanese trade, but all specimens over 4 cm represented wild-collected stock. Prices for wild-collected plants reached 15,300 yen (Table 5). In 1980 and 1981, 400 plants were reexported by the U.S. to Japan. Dealers often referred to the popularity of this species.

Backebergia

Another monotypic genus endemic to southern Mexico, Backebergia militaris is a large, tree-like species listed on Appendix I since 1983. Only offered by two of the dealers in the catalogue survey, trade in seeds and harvested tops or cephalia was found. Selling for 15,000-25,000 yen, in comparison to other species, these 40-70 cm cuttings were very expensive (Table 5) and probably only appeal to highly specialized collectors or botanical garden interests. CITES data record trade in live plants and seeds between the U.S. and Japan.

Borzicactus

Much confusion surrounds the taxonomy of Borzicactus, which has as many as 13 generic synonyms. Composed of generally tall, columnar species distributed in Andean habitats from Ecuador to Chile, only one species was identified in the Japanese trade, B. celsianus, which was rather expensively priced (Table 8). Twenty plants of this species, noted as artificially propagated, were exported to

Japan in 1983 according to U.S. CITES annual report data. Another 118 specimens of six other Borzicactus species, including 100 B. aureispinus, were also reported in the data, all as artificially-propagated plants.

Carnegiea

A monotypic genus found in the American Southwest and northern Mexico, Carnegiea gigantea plants can reach a height of 12 meters. Very uncommon in the Japanese trade, specimens 11-14 cm were found during the second catalogue survey for prices reaching 10,000 yen (Table 7). Five specimens were exported to Japan in 1982 according to U.S. CITES data.

Cephalocereus

Plants in this genus can grow to be 10 meters and weigh 600 kilos. Predictably, only small specimens enter trade. In the second catalogue survey, a 10.5 cm Cephalocereus chrysacanthus plant was found for 6,000 yen (Table 7). In the CITES data there was considerable trade in seeds as well as exports of 742 live, mostly artificially-propagated plants, including 377 C. palmeri and 302 C. senilis.

Copiapoa

An endemic Chilean genus of over 20 species, Copiapoa plants are regularly traded in Japan and apparently hold great interest to collectors. Perhaps the most typical representative of the genus, C. cinerea was the most common species in trade; at least five varieties were identified, of which columna-alba and dealbata were the most abundant. Prices were relatively expensive, reaching up to 75,000 yen with the cheaper range most likely representing damaged or less attractive plants (Table 8). In the CITES data, only trade in artificially-propagated plants was reported. Of a total of 304 plants, 300 were C. cinerea exported from the U.S. to Japan in 1983.

Coryphantha

Most Coryphantha species are small, globular cacti and of the almost 70 species that comprise the genus, most can be raised from seed (Oldfield, 1985). Three species were listed on CITES Appendix I in 1983. Although C. sneedii was not found for sale in Japan, the other two Appendix I species were. C. minima, endemic to a small area of Texas, is classified as "Endangered" under the ESA. Only one dealer was found to offer small cultivated plants and seeds. C. werdermannii, an endemic Mexican species, is listed as "Endangered" by IUCN. Only seeds were advertised in the Japanese trade (Table 5).

Only seven other Coryphantha species were identified in the Japanese trade, including two Mexican endemics which IUCN regards as "Vulnerable," C. elephantidens

and C. poselgeriana. The latter species was the most common Coryphantha species found in the survey, followed by C. bumamma. C. erecta plants were the most valuable, reaching prices of 25,000 yen (Table 7). Few Coryphantha were reported in the CITES data, except for annual trade in C. poselgeriana from the U.S. totalling 65 plants, some noted as artificially propagated. Only 39 other Coryphantha cacti were contained in the data.

Discocactus

Although five species are currently recognized with distributions in Bolivia, Paraguay, and Brazil, the genus could greatly expand taxonomically if collectors' numbers are any indication of new species yet to be fully described. In addition to the five recognized species, which include many varieties, plants identified only by collectors' numbers were abundant. Two species were found which could be vulnerable to trade pressure due to their restricted distributions (Oldfield, 1985), D. horstii and D. zehntneri, the latter being relatively common in the Japanese trade. Although Riha and Subik (1981) claim that D. horstii attains a maximum size of 6 cm, the plants found in Japan measured between 6.5 and 7.5 centimeters. Prices for Discocactus are moderate to expensive, and collector interest seems to be great in Japan at the present time (Table 8).

Only 3 Discocactus were reported in the CITES data between 1981 and 1984, all of which were noted as artificially propagated in the U.S., including one specimen each of D. hartmannii and D. horstii. The lack of CITES data for trade in this genus gives credence to the proposition that most trade to Japan originates from European countries who have yet to implement CITES reporting requirements for their cactus trade. F.R. Germany, in fact, did report receiving over 1,700 plants of this genus in 1984, all exports from Brazil.

Echinocactus

A very popular but relatively expensive genus in the Japanese trade, six barrel cactus species, including many varieties, were identified. The smallest representative of Echinocactus, E. horizonthalonius, was the most abundantly traded, although it is reported to be difficult to cultivate (Riha and Subik, 1981). In the wild, this species can attain up to 20 cm in size; in Japan the largest plants found were 16 cm priced at 20,000 yen. One variety of this species, nicholii, has been listed as "Endangered" under the ESA since 1971.

Almost as common were E. platyacanthus and E. parryi. Trade in E. grusonii, which is regarded as "Endangered" by IUCN, included at least three varieties. Although commonly propagated, the wild status of this species perhaps justifies its inclusion on CITES Appendix I (Sanchez-Mejorada, 1982). The most expensive offerings from the genus were 17 cm E. xeranthemoides plants priced at 58,000 yen and labeled "very rare in native habitat" (Table 7).

Echinocactus are regularly featured in U.S. trade with Japan. Almost all of these species are identified as reexports from Mexico. Over 2,350 plants were reported in the CITES data, including 1,318 E. horizonthalonius and 271 E. grusonii and 75 E. platyacanthus. The remainder of the species in trade were only identified at the genus level.

Echinocereus

The genus Echinocereus, which features both solitary globular and branching species, is rather uncommon in the Japanese trade. Only four of the almost 60 species were found in the first catalogue survey, including two protected under the ESA. Trade in E. reichenbachii var. albertii, listed as "Endangered" in 1979, involved only seeds or small artificially-propagated plants. A 4.5 cm wild-collected E. triglochidatus, priced at 3,000 yen, was found, but the variety was not identified (Table 6). Both E. triglochidiatus var. arizonicus and E. triglochidiatus var. inermis were listed as "Endangered" under the ESA in 1979.

Trade in E. pectinatus, including its most beautiful variety rigidissimus (Riha and Subik, 1981), and the diminutive E. knippelianus was also found. These were rather inexpensively priced below 3,500 yen. The second catalogue survey identified at least one large shipment of E. stramineus featuring many large plants and prices reaching 28,000 yen (Table 7).

Echinomastus

Trade in four of the five species of this genus, including one of the two CITES Appendix I species, was identified. Echinomastus mariposensis, found in southwest Texas and northern Mexico, has been heavily exploited throughout its range. Listed as "Threatened" under the ESA in 1979, E. mariposensis was moved to CITES Appendix I in 1983. Only one Japanese dealer offered seeds in this survey (Table 5). The other Appendix I species, E. erectocentrus, was not identified in the Japanese trade.

All three Appendix II species were identified, including E. unguispinus which IUCN regards as "Rare," but trade volumes were low (Table 7). In general, the genus is regarded as difficult to cultivate (Riha and Subik, 1981; Oldfield, 1985), which perhaps accounts for the general lack of popularity in Japan. A single artificially-propagated E. intertextus and 5 plants identified only as "Echinomastus spp." were listed in the CITES data.

Epithelantha

Although a monotypic genus, many varieties are known for Epithelantha micromeris. In the Japanese trade, the species is very abundant, particularly the variety bokei. Both E. micromeris var. greggi, regarded by IUCN as

"Indeterminate," and E. micromeris var. unguispina, listed as "Insufficiently known," were identified, the former being rather common. Generally moderately priced, large clumps fetch up to 29,000 yen (Table 7). Over 2,300 E. micromeris were included in the U.S. CITES data as reexports from Mexico to Japan, with trade steadily increasing each year.

Eriosyce

A monotypic genus of great variability and endemic to Chile, Eriosyce ceratistes is uncommon in the Japanese trade. Prices ranged up to 8,900 yen for 7-12 cm plants (Table 8). In the CITES data five artificially-propagated plants were exported by the U.S. to Japan in 1983.

Ferocactus

Although apparently easy to raise from seeds and keep in cultivation (Lamb and Lamb, 1975), most Ferocactus species take years to reach flowering size. Twenty-four of the 40 Ferocactus species were found in the catalogue survey. F. covillei and F. wislizeni were the most common species. A substantial trade in F. chrysacanthus, a Mexican endemic IUCN lists as "Endangered," is perhaps of greatest immediate concern as it involved a considerable range in plant size. Two other species common in trade, F. cylindraceus, which is rated as "Insufficiently known" by IUCN, and F. rectispinus were both unsuccessfully proposed for inclusion in CITES Appendix I in 1983. Species noted for their beautiful spines, F. gracilis and F. pilosus, the latter categorized as "Indeterminate" on the IUCN list of Mexican endemics, were also common. Generally, prices for Ferocactus were not cheap. The most expensive species, F. diguetii var. carmensis, reached 54,000 yen (Table 7).

In the CITES data, trade in at least 20 species was reported, only two of which were not found in the catalogue survey, F. ingens and F. townsendianus. Totalling more than 1,700 plants, most were of Mexican origin reexported by the United States. Annual trade in F. pilosus and F. latispinus, two species common in the catalogue survey, was found.

Gymnocactus

Only two of the nine species in this genus of small, rounded plants endemic to Mexico were identified. Gymnocactus mandragora is classified as "Endangered" by IUCN and G. beguinii is ranked as "Vulnerable." Only small, inexpensive plants were found for sale in the catalogue survey (Table 7). A total of 119 plants of both species was reported as reexports from Mexico in the U.S. CITES annual report data. An additional 3 specimens of two other species were also listed as cultivated plants.

Gymnocalycium

A large genus of between 60 to 100 species, Gymnocalycium plants were uncommon in the catalogue survey. Two species with Bolivian distribution, G. cardenasianum and G. eytianum, were identified (Table 7). One artificially-propagated specimen of the former species appeared in the U.S. CITES data as an export to Japan. Otherwise, only 31 plants were reported in the CITES data, including 20 artificially-propagated plants from the Netherlands in 1984.

Homalocephala

A monotypic genus, Homalocephala texensis was one of the most abundant species in trade. Many catalogues distinguished between plants originating from Texas or Mexico. The average price was expensive, over 10,000 yen per plant (Table 7). According to CITES data, trade fluctuated considerably from 1981 through 1984, and involved only 476 plants. Of these, only 5 were exported to Japan in 1984. Virtually all trade involved reexports of Mexican plants. Other trade in this species must have occurred directly from Mexico to account for its frequency on the Japanese market.

Leuchtenbergia

Leuchtenbergia principis, listed as "Vulnerable" by IUCN, comprises this monotypic genus endemic to Mexico. Although L. principis has a wide distribution, overcollection has seriously affected this popular species, which was moved to CITES Appendix I in 1983. In Japan, inexpensive, small cultivated specimens are commonly available, but there is also considerable trade in large, wild-collected plants measuring up to 35 cm and priced up to 23,000 yen (Table 5). CITES data report limited trade between the U.S. and Japan.

Lophophora

The genus Lophophora, commonly known as peyote, is under considerable commercial pressure for the Japanese market. Large-scale trade in wild-collected L. williamsii was found, with not only single plants, but also rare fasciated specimens and plant clumps available for prices reaching 130,000 yen. The varieties lutea, diffusa, and fricci were common, often as large clumps (Table 7). Limited trade in artificially-propagated plants was also found. Lophophora williamsii var. diffusa is regarded as severly endangered in the wild (Sanchez-Mejorada, 1982).

CITES data reported trade in over 7,000 Lophophora plants, but, from a high of 3,433 in 1981, U.S. reexports of Mexican plants dropped steadily to zero in 1984. This may reflect an effort on the part of U.S. authorities to curtail trade in this species. In the U.S., trade and possession of this species is strictly regulated by the Controlled Substances Act. In Japan, demand for Lophophora plants seems to be confined to horticultural interests and not drug-related activity.

Mammillaria

Of the more than 160 species that comprise this genus, only three have been listed on CITES Appendix I. These were all identified in the Japanese trade, but not as wild-collected plants. Mammillaria pectinifera and M. plumosa, both with very restricted ranges in Mexico and regarded by IUCN as "Endangered" and "Vulnerable" respectively, were generally traded as small inexpensive artificially-propagated plants or as seeds. However, numerous large specimens of M. plumosa were available and rather expensive, reaching up to 13,000 yen. They were, in fact, the only artificially-propagated plants that carried prices in this range. M. plumosa was very common in the Japanese trade, with nine out of ten dealers surveyed offering it for sale, but oddly enough no seeds were identified in trade (Table 5). M. solisioides, another popular Mexican endemic classified as "Vulnerable" was featured only as seeds.

Considerable trade in other Mammillaria species was found. Twenty-two species were identified in the catalogue survey, while CITES data list 103 species. Eight Mexican endemics classified as "Vulnerable" by IUCN, M. albicoma, M. aureilanata, M. dixanthocentron, M. humboldtii, M. lenta, M. carretii, M. guelzowiana and M. hahniana were found in the catalogue survey. Four others, M. glassii, M. nana, M. parkinsonii, and M. pennispinosa are regarded as "Rare" species. Another, M. schwarzii, is considered "Indeterminate" by IUCN and was proposed for inclusion on CITES Appendix I in 1983 (as M. coahuilensis). The most common species, M. formosa, averaged about 16 cm in size. Prices varied, but the most expensive species, M. chionocephala, M. dixanthocentron, M. magnimamma, M. parkinsonii, and M. perbella were also the largest plants (Table 7).

While the CITES data featured a proliferation of taxa, three species identifed in the catalogue survey were not included. Trade totalled 1,946 plants from 1981 through 1984, with two-thirds representing U.S. exports of artificially-propagated specimens. For most species, only a couple of cultivated specimens were reported from any given year and trade was generally irregular. Reexports of Mexican Mammillaria specimens by the U.S. included 207 M. geminispina, 100 M. wildii, and 90 M. coahuilensis. M. lenta was found in trade each year and totalled 80 plants. M. parkinsonii and M. humboldtii appeared in the data twice for a total of 137 plants.

Melocactus

A widely distributed genus of some 50 species ranging from South America to Mexico and throughout the Caribbean, most Melocactus plants found in the Japanese trade are native to Brazil or Peru. Many plants identified with only collectors' numbers were offered (Table 8). In 1981, a total of 238 plants were listed in the U.S. CITES data as exports to Japan, including two species not found in the catalogue survey. Since then only four plants have been reported.

Neoporteria

Another genus with up to eight generic synonyms, Neoporteria species found in the Japanese trade all were part of the subgenus Islaya. All four species have Peruvian distributions and were modestly priced (Table 8). In the CITES data, only five artificially-propagated specimens were reported as exports from the U.S. to Japan, including N. krainziana and N. islayensis.

Obregonia

Heavily affected by trade, this monotypic genus is endemic to Mexico. Regarded as "Endangered" by IUCN, O. denegrii was listed on CITES Appendix I in 1981. Considerable trade in larger, wild-collected specimens exists, although inexpensive, cultivated plants are available. One extraordinary, fasciated specimen was offered for 85,000 yen (Table 5). It is doubtful that the grafted specimen priced at 20,000 yen was in fact artificially propagated, although it was identified in the catalogue as such. Probably the stock was cultivated, but the scion was taken from the wild. A total of 341 plants, over half reportedly cultivated, were listed as reexports to Japan in the U.S. CITES annual reports. This species remains popular among collectors, according to Japanese dealers.

Ortegocactus

Another monotypic genus with a distribution limited to a single mountaintop in Mexico, Ortegocactus macdougallii is ranked as "Vulnerable" by IUCN. In Japan limited trade was found, with plants up to 11 cm moderately priced below 6,000 yen (Table 7). In the CITES data, the U.S. reexported 600 Mexican plants to Japan in 1982.

Pediocactus

In the genus Pediocactus, featuring nine dwarf species mostly distributed in the American Southwest, eight were listed on CITES Appendix I in 1983. Of these, two were identified in the catalogue survey. P. knowltonii, also listed as "Endangered" under the ESA in 1979, was offered by one dealer in Japan for 7,300 yen to 7,500 yen (Table 5). A single artificially-propagated specimen was exported to Japan from the U.S., according to CITES annual report data. Trade in P. peeblesianus involved several inexpensive artificially-propagated grafts of P. peeblesianus var. peeblesianus (Table 5). This variety is limited to a small area of northeastern Arizona, where it is protected by state law, and was listed on the ESA as "Endangered" in 1979.

Only limited trade in one other species, P. simpsonii, was found involving small, rather inexpensive plants (Table 7). This species is perhaps the easiest in the genus to maintain in cultivation. Other than trade in P. knowltonii, the CITES

data do not document any trade in this genus.

Pelecyphora

The genus Pelecyphora was listed on CITES Appendix I in 1981. Generally only two species are recognized, P. aselliformis and P. strobiliformis. A Mexican endemic, P. aselliformis is highly coveted in international trade. On the Japanese market there was an abundance of wild-collected plants. Seeds and small artificially-propagated specimens were also found in the catalogue survey, but this trade, in comparison to imports, is very limited (Table 5). A total of 224 cultivated plants originating from Mexico were imported to Japan from the U.S. according to the CITES data.

P. strobiliformis, found in only a few locations in northern Mexico, was also very common in the Japanese trade, with nine out of ten dealers surveyed offering the species. Propagated plants measuring up to 3 cm were popular in the trade, but there was also an abundance of larger wild-collected plants on the market (Table 5). Although CITES data did not list any trade in P. strobiliformis, some of the over 3,000 plants reported as "Pelecyphora spp.," all reexports from the U.S., certainly included this species.

Peniocereus

Of the 15 Peniocereus species distributed in Mexico and the U.S., only P. greggii was found for sale in the second catalogue survey. These plants were expensive, priced between 8,500 and 15,000 yen (Table 7). CITES data contained little evidence of trade in this genus: a single plant and one piece were reported as exports to Japan by the United States.

Rodentiophila

An endemic Chilean genus of three species, trade in one species identified as Rodentiophila latispina var. solaris (not a recognized taxa in the WTMU Taxatab list) was found (Table 8). The CITES annual report data did not feature any trade in this genus.

Sclerocactus

Another genus of six species predominantly distributed in the southwestern part of the U.S., four were listed on CITES Appendix I in 1983. Two of these, Sclerocactus mesae-verdae and S. wrightiae, both protected under the ESA since 1979, were traded in Japan. A 6 cm specimen of the former species was found for sale for 23,000 yen. Another dealer offered 1.5-3.3 cm wild-collected specimens of the latter (Table 5).

Trade was found in one other species, S. whipplei, one of the most prominently spined cacti in the genus. Small plants of 8 cm sold for up to 28,000 yen (Table 7). No trade in this genus was reported in the CITES data.

Stenocactus

Stenocactus species from Mexico, usually sold in Japan under their generic synonym Echinofossulocactus, are generally small multi-ribbed plants. The one exception, S. coptonogonus, which has few ribs and grows up to 30 cm in height (Riha and Subic, 1981), was identified in the Japanese trade. Two other species were also found, including S. multicostatus, which has as many as 120 wavy ribs and is regarded as a particularly attractive species. Although Stenocactus species are generally priced in the middle range, fairly small S. kellerianus plants were as cheap as 500 yen (Table 7). CITES data included 333 S. multicostatus and 37 S. coptonogonus, all of Mexican origin reexported by the United States.

Strombocactus

Endemic to Mexico, Strombocactus disciformis is the only species in this genus. With an IUCN category of "Vulnerable," this species was placed on CITES Appendix I in 1983. One of the most frequently encountered Appendix I cactus in the Japanese trade, nine out of ten dealers offered this species. Limited trade in small cultivated plants exists, but larger wild-collected specimens are the mainstay of the trade. Usually moderately priced, S. disciformis plants with unusual fasciation were advertised for the exceptional price of 140,000 yen. Grafted specimens found in the trade were always more expensive than cutivated plants (Table 5). Shipments of this species were received every year between 1980 to 1983 from the U.S. and totalled 1,155 plants according to CITES data.

Stetsonia

A monotypic genus endemic to Argentina, large Stetsonia coryne plants were expensively priced, ranging up to 38,000 yen (Table 8). No trade was reported in the CITES annual report data for this genus.

Thelocactus

A rather popular U.S. and Mexican genus of small, generally solitary growing plants, Thelocactus hexaedrophorus and T. rinconensis were particularly abundant in the Japanese trade for modest prices. One exceptionally large fasciated T. hexaedrophorus var. fossulatus plant was priced at 32,000 yen. Prices for the species usually ranged around 5,000 yen. T. macdowelli, classified by IUCN as "Rare", was offered by one company (Table 7).

CITES reported trade involved the three most popular Thelocactus species identified in the catalogue survey; however, only a total of 30 plants were

reported, all U.S. exports. Other direct importation from Mexico certainly occurred in order to account for the abundance of specimens found on the Japanese market.

Turbinicarpus

A genus of diminutive plants endemic to Mexico, all Turbinicarpus species were listed on CITES Appendix I in 1983. In Japan, trade in both wild-collected and artificially-propagated plants was rather common, involving all six species and several varieties.

Much less common than the other species, only one dealer offered mature plants of T. laui, regarded as "Endangered" by IUCN. Limited trade in small, cultivated plants was also found, but seeds were more frequently offered. Most trade in T. valdezianus involved wild-collected plants, but small, inexpensive artificially-propagated specimens were also available, many advertised as grafts. T. lophophoroides, also classified as "Endangered" by IUCN, is known to have a limited distribution. In Japan most trade involved wild-collected plants which were moderately priced. A few inexpensive artificially-propagated specimens were also noted, as well as trade in seeds (Table 5).

The distribution of T. pseudomacrochele is not well known, but the species is regarded as "Endangered" by IUCN. Both the nominate species and T. pseudomacrochele var. krainzianus were rather common in the Japanese trade as inexpensive propagated plants. A very limited trade in small imported T. pseudomacrochele plants was also found, as was trade in seeds (Table 5).

Restricted to northeast Mexico and threatened by both trade and development, T. pseudopectinatus is listed as "Endangered" by IUCN. Most Japanese trade involved cheaply-priced wild plants. (Later discussions with dealers indicated that these probably represented imports in poor condition.) Some trade in seeds and small cheaper cultivated plants exists, as well as trade in grafted specimens (Table 5).

With six well-differentiated varieties occurring in fairly isolated populations, T. schmiedickianus is classifed as "Endangered" by IUCN. By far the most common Appendix I species in trade, all dealers carried at least one or more varieties. The nominate species was most abundantly featured in the import trade. Small numbers of wild-collected plants were also available for T. schmeidickianus vars. flaviflorus, gracilis, macrochele, and klinkerianus. All varieties, including T. schmeidickianus var. schwarzii, were available as cultivated plants. (Table 5).

CITES data include trade, reported only at the genus level, in over 2,000 specimens from the U.S. to Japan. Trade in artificially-propagated specimens included three T. lophophoroides, 24 T. pseudomacrochele, and almost 50 T. schmiedickianus, most reexported from Mexico to Japan by the United States. It is

very likely, however, that some of these plants were wild-collected. The data further report that the U.S. reexported almost 1,400 T. pseudopectinatus and 300 T. valdezianus of Mexican origin to Japan.

Uebelmannia

The endemic Brazilian genus Uebelmannia is another South American cactus group still subject to taxonomic development. Six of the seven recognized species were found in the Japanese trade, as well as another species identified as U. amnothrophus and other plants with only collectors' numbers. U. pectinifera, a species discovered only 18 years ago and limited to the southern part of Minas Gerais in Brazil (Riha and Subik, 1981), was the most common species in trade. U. pectinifera showed the greatest range in size and price, the most expensive plants reaching 32,000 yen (Table 8). Apparently difficult to maintain in cultivation, the genus nonetheless has great appeal to collectors.

In the CITES data, only 28 artificially-propagated U. pectinifera plants were reported by the U.S. as exports to Japan. Other, unreported trade certainly originated from Europe, most probably the Netherlands and F.R. Germany. In fact, German CITES data for 1984 show imports of over 670 Uebelmannia plants from Brazil.

Wilcoxia

Of the several Wilcoxia species, only one is listed on CITES Appendix I. W. schmollii, with a restricted distribution in central Mexico, was moved to Appendix I of CITES in 1983. Although not common in the Japanese trade, wild-collected plants of an unspecified size were available from two dealers. One dealer also offered very small inexpensive cultivated plants, but no trade in seeds was identified (Table 5). CITES annual report data only listed trade at the genus level, some of which could have included this species.

Conclusion and Recommendations

Although the importation of cacti has reportedly declined over the last 20 years, cacti continue to enjoy considerable popularity on the Japanese market. Japan's role as a leading producer of artificially-propagated cacti is certainly welcomed by conservationists all over the world. However, her other role as a major importer of wild-collected cacti, including many rare and endangered species, is cause for concern. The following points have been documented in this report and characterize Japan's cactus trade:

1. Many wild-collected Appendix I species are still heavily traded in Japan despite CITES controls. For many of these species, even when available as artificially propagated specimens, the principal demand is for wild-collected stock.

This report clearly documents a considerable trade in wild-collected plants of at least half of the Appendix I species prohibited from international commercial trade by CITES (Table 5). While some of the Appendix I species are also being cultivated in Japan, it is evident that slow-growing species, like those from the genera Ariocarpus and Pelecyphora, Aztekium, and Strombocactus, are in demand primarily as wild-collected plants. This trade is believed to violate CITES and clearly presents a very serious challenge to those in charge of law enforcement in Japan.

2. Japan is not properly implementing CITES for plants and Japanese Customs inspectors remain ineffective in halting illegal trade.

This report documents a steady flow of Appendix I cacti species into Japan that are widely sold on the Japanese market. Publications put out by certain dealers allude to trade in contravention of CITES. Other dealers interviewed in the course of this study indicated that it did not take much effort to "fool" Customs officers. At the present time, Customs officers do not have sufficient identification materials at their disposal to adequately police the trade. Further, there is little coordination between Customs and plant quarantine inspectors, who, for their own purposes, spend more time with shipments of plants than Customs officers do. Once passed Customs inspection, there is no legal mechanism to challenge the sale of wild-collected Appendix I species on the Japanese market. A mechanism for investigating suspected violations of CITES has yet to be developed by the Japanese CITES Management Authority. It is clear that Japan must thoroughly review and reconstruct fundamental CITES procedures for plants in order to rectify the situation. At the same time, broader enforcement capabilities must be developed.

3. Illegal trade into Japan involves a number of countries and a variety of methods.

Appendix I species and other wild-collected cacti have been illegally shipped from the U.S., Mexico, and the Netherlands to Japan. Other European countries, particularly F.R. Germany, are also suspected to be involved, but because the quality of the CITES annual reports is so poor, documented evidence is not currently available. Wild-collected cacti, including Appendix I species, have been shipped from the Netherlands under the guise of "artificially-propagated" stock. For a number of years, the U.S. regularly "laundered" Mexican cacti, including a number of Appendix I species, by issuing reexport documents. More recently, U.S. dealers are believed to have shipped out Appendix I specimens concealed in shipments of cultivated cacti. Direct trade from Mexico, a country not party to CITES, is believed to occur without proper documents. Stringent enforcement practices in Japan coupled with a cooperative international effort would improve the situation considerably.

4. Reporting of cactus imports in the CITES annual reports of Japan and other countries is inadequate and serves to mask illegal trade.

By reporting all trade in cacti simply as "Cactaceae spp." in the Japanese CITES annual report, illegal trade in Appendix I species and other wild-collected cacti is able to flourish undetected. At the same time, data from European reexporters, the Netherlands, F.R. Germany, and Denmark, when it is available at all, is also poor and further inhibits proper monitoring. Only the U.S. seems to make an effort to properly report trade in cacti. The only solution is for all CITES Parties to report trade in cactus at the species level in their annual reports.

5. Many wild-collected specimens of Appendix II species which are regarded as threatened by IUCN's Threatened Plants Unit or other authorities are traded in Japan.

Although most cactus species have not been assigned a conservation category by IUCN's TPU, a report on threatened Mexican endemics has been produced. Many of these were found in the Japanese trade. Several Appendix II species listed as "Endangered" by IUCN, Echinocactus grusonii, Ferocactus chrysacanthus, and Gymnocactus mandragora, were identified. High volume trade in species regarded as "Vulnerable," particularly the three Appendix II Ariocarpus species, Astrophytum myriostigma, and possibly Ortegocactus macdougallii, give cause for concern. Other species regarded as severly threatened in the wild, Astrophytum asterias and Lophophora williamsii var. diffusa (Sanchez-Mejorada, 1982), or considered vulnerable to trade pressure, Discocactus horstii and D. zehntneri (Oldfield, 1985), are popular in Japan. Some of these species, particularly all Appendix II Ariocarpus and Astrophytum asterias, should be considered for listing on CITES Appendix I. Field studies are also needed to determine the status of South American species currently popular in trade.

6. Wild-collected plants are considerably more valuable than propagated specimens.

The difference in prices between wild-collected plants and propagated plants demonstrates how valuable wild imports are to Japanese traders. For all Appendix I species identified in this study, prices for wild-collected plants far exceeded those for propagated stock, the only exception being when prices were marked down for specimens in poor condition. For many species, only the older plants will produce flowers thus increasing their value. In addition, Japanese collectors appreciate the individual character that wild-collected plants exhibit. For example, the smallest wild-collected Aztekium ritteri at 2 cm would still sell for at least 3,000 yen and larger plants would fetch over 15,000 yen. In comparison, the largest artificially-propagated A. ritteri, measuring 4 cm, would cost no more than 700 yen (Table 5). While comparative data were not tabulated for Appendix II species, similar patterns were noted in the data. And finally, it appears that prices for wild-collected plants are rising all the time perhaps reflecting their increased rarity and protection.

7. The Japanese fascination with bizarre and unusual plants stimulates demand and prompts tremendous prices to be paid for such specimens.

Cacti that exhibit bizarre or unusual characteristics sell for fantastic prices. This trade includes both Appendix I and II species. Fasciated Strombocactus disciformis plants, for example, were offered for up to 140,000 yen. Large, fasciated Ariocarpus retusus and A. fissuratus were priced as high as 185,000 and 300,000 yen respectively and one, Astrophytum myriostigma var. coahuilense, was priced at 330,000 yen. Similarly, large clumps of Lophophora plants and other caespitose species are very expensive. Dealers indicated that there is always a demand by collectors, who are clearly willing to pay some of the highest prices in the world for these aberrant but fascinating specimens.

8. Japanese prices for wild-collected cacti are perhaps the highest in the world.

For almost all species of cacti identified in the Japanese trade, prices are substantially more expensive than similar specimens found for sale in a survey of U.S. cactus and succulent nursery catalogs between 1982 and 1984 (Fuller 1985a). Although few data exist for prices of wild-collected cacti in other parts of the world, Japanese prices are likely to represent some of the highest in the world.

9. Many species suffer considerable mortality during transportation to Japan or during the rooting process adding to the pressures on wild populations.

Mortality of cactus species in trade is a subject little documented. Information obtained from Japanese importers indicates that certain heavily-traded genera also suffer considerable mortality during the importation process (Table 4). Astrophytum asterias stands out as an example of a threatened Appendix II species which suffers high losses. Other Appendix II species from the genera Ariocarpus, Uebelmannia, Copiapoa, and Discocactus, which currently enjoy considerable popularity in Japan, also suffer relatively high mortality in trade. Further studies on cactus mortality need to be undertaken to identify vulnerable species and take appropriate conservation action.

Recent Developments

Recent events in Japan indicate that improvement in plant trade enforcement is already taking place. On April 20, 1986 TRAFFIC(Japan) held a press conference highlighting the results of this report and appealing to the government to forcefully implement CITES for trade in cacti species. The event garnered considerable news coverage in both the print and television medias. Within 24 hours, customs authorities halted the import of 177 cacti that had arrived at Narita Airport, apparently from Mexico without any export documents. Officials

compelled the importer to relinquish his rights of possession to the government and it is likely that the cacti will be turned over to a botanical garden. A few days later, another shipment involving over 1,000 cactus specimens was halted entering Japan from the United States. Investigations are still pending and it remains to be seen if these plants will be allowed to be imported.

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Table 1
Japan Cactus Imports from the U.S., 1981-1984
Comparison of Data Sources

1981		1982		1983		1984	
Japan Data	US Data	Japan Data	US Data	Japan Data	US Data	Japan Data	US Data
18,430	23,606	6,194	13,252	12,068	18,237	6,534	6,059
—	—	88 Kg	—	3,329 Kg	—	1,320 Kg	—

Key
No Unit=Live Plants
Kg=Kilos
Sources
Japan and U.S. CITES annual report data, 1981-1984

Table 2
Japan Cactus Imports from the U.S. and Mexico, 1981-1984
Comparison of Data Sources

Country of		1981		1982		1983		1984	
EX	OR	Japan Data	U.S. Data	Japan Data	U.S. Data	Japan Data	U.S. Data	Japan Data	U.S. Data
MX	MX	6,418	—	6,670	—	10,585	—	2,917	—
			—	900 Kg	—	35 Kg	—	23 Kg	—
MX	US	0	—	0	—	4,700	—	0	—
US	MX	13,031	22,383	0	12,126	5,300	13,869	782 + 1,320 Kg	5,401

Key
No Unit=Live Plants, Kg=Kilos, C=Cartons.
IM=Import, EX=Export, MX=Mexico
OR=Origin, US=United States
Sources
Japan and U.S. CITES annual report data, 1981-1984

Table 3
Japan Cactus Imports, 1981-1984

Country of Export	1981 Volume	1982 Volume	1983 Volume	1984 Volume
CA	52	—	—	—
CL	501 Kg	—	—	—
CN	—	83,150	—	—
CO	—	—	—	14 Kg
DD	114	—	—	—
DK	45,890	—	1,700	—
GB	—	—	1	—
MX	6,418	6,670	15,285	2,917
		900 Kg	35 Kg	23 Kg
NL	80,200	49,000	9,333 Kg	5,000 Kg
				8 C
PE	2,305	97	—	—
TW	—	—	500	3,800
US	18,430	6,194	12,068	6,534
	1 C	88 Kg	3,329 Kg	1,320 Kg
TOTAL	153,409	145,364	37,187	19,951
	501 Kg	988 Kg	3,364 Kg	1,357 Kg
	1 C			8 C

Key
No unit=Live Plants, Kg=kilograms, C=Cartons

Country Codes
CA=Canada, CL=Chile, CN=China, CO=Colombia, DD=German Democratic Republic, DK=Denmark, GB=United Kingdom, MX=Mexico, NL=Netherlands, PE=Peru, US=United States, TW=Taiwan

Source
Japan CITES annual reports, 1981-1984

Table 4
Relative Mortality for Cactus Genera and Species
Imported to Japan

Genus/Species	Mortality during Transportation	Mortality during Rooting
Ariocarpus	M	M
Astrophytum	L	L
A. asterias	H	H
Aztekium	H	H
Blossfeldia	H	H
Cereus	L	L
Copiapoa	L	H
Discocactus	M	M
Echinocactus		
E. grusonii	L	L
E. polycephalus	H	H
E. ingens	L	L
Echinomastus	H	H
Epithelantha	M	M
Ferocactus	L	L
Frailea	L	L
Gymnocalycium	L	L
Lobivia	L	L
Lophophora	L	L
Mammillaria	L	L
Neoporteria	L	H
Notocactus	L	L
Opuntia	L	L
Oroya	L	L
Ortegocactus	M	M
Parodia	L	L
Pediocactus	H	H
Pelecyphora	M	M
Sclerocactus	H	H
Strombocactus	M	M
Stenocactus	M	M
Thelocactus	L	L
Uebelmannia	M	M

Key
H=high mortality
M=moderate mortality
L=low mortality
Sources
Interview with Japanese importer; David Hunt, pers. comm.

Table 5
CITES Appendix I Species Found in the Japanese Trade,
January 1982-March 1984

Species	Wild-collected		Artificially Propagated		Seeds	No. of Companies
	Size (cm)	Price (yen)[1]	Size (cm)	Price (yen)[1]		
Ariocarpus agavoides	1.4-7	1,200-10,000	1.5-3	300-1,300	X	9
Ariocarpus scapharostrus	3.5-10	1,300-12,000	1-5.4	200-1,200	X	9
Ariocarpus trigonus	8.5-31	2,800-30,000	2-8	200-1,000	X	9
Aztekium ritteri	2-10	3,000-15,300	2-4	250-700	X	8
Backebergia militaris	40-70 (H)	15,000-25,000	—	—	X	2
Coryphantha minima*	—	—	2	300	—	1
Coryphantha werdermannii	—	—	—	—	X	1
Echinomastus mariposensis*	—	—	—	--	X	1
Leuchtenbergia principis	10-34 (H)	2,000-23,000	5-18 (H)	200-1,200	X	9
Mammillaria pectinifera	--	—	2-4.5	200-1,500	X	5
Mammillaria plumosa	—	—	2-34	70-13,000	—	9
Mammillaria solisioides	—	—	—	—	X	1
Obregonia denegrii	7-10	3,000-8,000	2-7	100-1,100	X	9
	18x16 (F)	85,000	(G)	20,000 (?)		
Pediocactus knowltonii*	1.5	7,300-7,500	—	—	—	1
Pediocactus peeblesianus*	--	—	2-3 (G)	600-1,000	—	1
Pelecyphora aselliformis	3-14	1,800-12,500	3	300-500	X	7
Pelecyphora strobiliformis	3-8	1,300-12,000	1-3	200-1,200	X	9
			(F) (G)	800-2,000		

Table 5
CITES Appendix I Species Found in the Japanese Trade,
January 1982-March 1984

Species	Wild-collected		Artificially Propagated		Seeds	No. of Companies
	Size (cm)	Price (yen)[1]	Size (cm)	Price (yen)[1]		
Sclerocactus mesae-verdae*	6	23,000	--	--	--	1
Sclerocactus wrightiae*	1.5-3.3	3,800-5,800	--	--	--	1
Strombocactus disciformis	5-12	1,600-9,500	2-4.5	350-1,000	X	9
	8.8-18.7(F)	15,000-140,000	3.5-5(G)	2,000-4,500		
			(F)	700-1,300		
Turbinicarpus laui	2.5-4	2,000-2,500	1-4.5	300-850	X	3
Turbinicarpus lophophoroides	3.5-5	900-3,500	1.5-4.5	150-1,100	X	6
Turbinicarpus pseudomacrochele	2-3.8	900-1,500	2-5	250-950	X	8
T. pseudomacrochele var. krainzianus	--	--	1.3-4.5	300-600	X	7
Turbinicarpus pseudopectinatus	2-5.5	450-2,800	1-3	200-500	X	6
			2-4 (G)	500-1,000		
Turbinicarpus schmiedickeanus	2-4	800-3,500	1.5-4	100-700	--	9
T. schmiedickeanus var. flaviflorus	--	--	1.5-4	500-1,200	X	3
T. schmiedickeanus var. gracilis	1.5-2	850	(S)	700	X	2

Table 5

CITES Appendix I Species Found in the Japanese Trade, January 1982-March 1984

Species	Wild-collected		Artificially Propagated			
	Size (cm)	Price (yen)1	Size (cm)	Price (yen)1	Seeds	No. of Companies
T. schmiedickeanus var. klinkeranus	2.7-3	1,800-3,500	1.2-2	120-400	X	4
T. schmiedickeanus var. macrochele	2.5	2,500	1-4	250-700	X	7
T. schmiedickeanus schwarzii	—	—	1.5-3.5	200-1,000	X	6
T. valdezianus	1.5-2.5	800-3,500	1.2-2	800-3,500	X	6
Wilcoxia schmolli	?	1,000-3,500	1.5-2.5	350-600	—	2
			?	200-500		

Key

*=Also protected by the U.S. Endangered Species Act

Size

(H)=Height
(F)=Fasciated
(G)=Graft
(S)=Small size
NG=Not Given
X=Available as seed
?=It is questionable whether this plant actually represents artificially propagated stock. The price would indicate the scions were from wild-collected plants.

Price

1=Average dollar/yen exchange rate for 1/82-3/84: $1=239 yen

Table 6:
Taxa listed by the U.S. Endangered Species Act Found in the Japanese Trade, January 1982-March 1984
(Excluding Species Also Listed on CITES Appendix I)

Species	Wild-collected		Artificially Propagated	
	Size (cm)	Price (yen)[1]	Size (cm)	Price (yen)[1]
Echinocereus reichenbachii var. albertii	---	---	4-7 (H)	150-500
Echinocereus triglochidiatus	4.5	3,000	M (H)	250
			4 (H)	500 (G)
			5 (H)	180

Key

Size
cm=Centimeters
(H)=Height
(G)=Graft

Price
[1]yen=Japanese yen
Average yen/dollar exchange rate 1/82-3/84: $1=239 yen.

Table 7
Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
ANCISTROCACTUS					
A. scheeri (as A. megarhizus)	4.5-7	1,800-2,800	MX, US	2	C2
ARIOCARPUS					
A. fissuratus (as Roseocactus fissuratus)	6-18 10-23 (C) 11.5	1,600-58,000 9,000-30,000 300,000	MX	8	C1,2,3,4
A. kotschoubeyanus (as Roseocactus kotschoubeyanus)	1.5-10	600-15,000	MX	8	C1,2,3,4 IUCN = V
A. retusus	7-31 13-38(F) 7-36(C)	1,800-75,000 20,000-185,000 5,000-70,000	MX	8	C1,2,3,4 IUCN = V
ASTROPHYTUM					
A. asterias	5-14	1,000-150,000	MX, US	3	C1,2,3 IUCN = V
A. capricorne	9-11.7	2,500-7,000	MX	4	C1,2,3,4 IUCN = V
A. capricorne var. senile (as A. senile)	8.5-13	3,200-7,500		4	

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen)[1]	Distribution	No. of Companies	Comments
A. myriostigma	6-20	900-30,000	MX	3	C1,2,3 IUCN-V
	16-24.5(F)	40,000-65,000			
A. myriostigma var. coahuilense (as A. coahuilense)	8.5-16	2,500-20,000		6	
	15-40(F)	45,000-330,000			
	26-29	130,000-150,000			
CARNEGIEA					
C. gigantea (2)	11-14	7,500-10,000	MX, US	1	C2
CEPHALOCEREUS					Cg3/Ct1,2,3,4
C. chrysacanthus (2) (as Pilocereus chrysacanthus)	10.5	6,000	MX	1	
CORYPHANTHA					
C. bumamma	13-15	2,500-5,000	MX	3	
C. coahuilensis (?)	3.8	3,500	MX	1	
C. cornifera	18.5	6,500	MX	1	
C. elephantidens	9-16.5	6,500-9,000	MX	2	IUCN-V

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
C. erecta	NG	10,000-25,000	MX	1	
C. poselgeriana	6-17	4,000-8,000	MX	4	C1,2,3,4, IUCN-V
C. radians	13.5	6,500	MX	1	
ECHINOCACTUS					
E. grusonii	31-45	17,000-38,000	MX	2	
E. grusonii var. albispinus	15-34	5,500-38,000		2	
E. grusonii var. curvispinum	23	18,500		1	
E. grusonii var. NG	20-21	11,000-12,000		1	
E. horizonthalonius	9-16	4,000-20,000	MX, US	6	C1,2,3,4
E. parryi	11.5-19	8,500-30,000	MX	4	C1,2,3,4
E. platyacanthus (as E. palmeri)	20-44	8,000-35,000	MX, US	5	C2,3
E. platyacanthus (as E. grandis)	26	20,000			
E. platyacanthus (as E. ingens)	16.5	5,000		1	

Table 7
Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
E. polycephalus	26-30(C)	19,500-32,500	US	2	
E. xeranthemoides	11-17	12,000-58,000	US	2	
ECHINOCEREUS					Cg3/Ct3,4
E. knippelianus	3-8	1,200-3,000	MX	1	IUCN-V
E. pectinatus	7-8	1,800-3,000	MX	1	
(as E. dasyacanthus)	7.5(C)	7,500			
E. pectinatus var. rigidissimus	6-8	3,000-3,500	MX, US	1	C2,3
E. stramineus (2)	28-36	5,000-28,000	MX, US	1	
ECHINOMASTUS					Cg2
E. intertextus	6	4,800	MX, US	1	C4
E. johnsonii	25	12,000	US	1	
E. unguispinus	9-10	5,000-7,000	MX	1	IUCN-R
EPITHELANTHA					Cg1
E. micromeris	3-11.5	1,200-6,800	MX, US	5	C1,2,3,4
	15.5(C)	28,000			
E. micromeris var. bokei (as E. bokei)	1.8-4.5	1,000-5,500	MX, US	5	

Table 7
Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
E. micromeris var. brunispina	6.5-14	4,300-12,800	US	1	
E. micromeris var. greggii	2.5-24	1,200-29,000	MX	3	IUCN-I
E. micromeris var. longicaulis	5.3-8.6	4,300-6,800	US	1	
E. micromeris var. unguispina	2.8 7-11.5(C)	1,850-2,850 8,500-9,500	MX	1	IUCN-K
FEROCACTUS					
F. bicolor var. tricolor (as Thelocactus bicolor var. tricolor)	9-11.	3,300-4,800	MX	1	Cg1,2,/Ct1,2,4 C3,4
F. chrysacanthus	3-18	1,500-32,500	MX	2	C1,2, IUCN-E
F. covillei (as F. rostii)	14-23	10,000-23,000	MX, US	4	C2,3
F. cylindraceus (as F. acanthodes)	17-31 NG	6,000-38,000 18,000	MX, US	3	C1,1*,2*,4

Table 7
Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen)[1]	Distribution	No. of Companies	Comments
F. cylindraceus (as F. tortulospinus)	11-17	9,000-18,000	MX	2	IUCN-K
F. diguetii var. carmenensis	13-20	10,000-54,000	MX, US	3	C1,2
F. echidne	21	18,000	MX	1	C4
F. echidne (as F. victoriensis)	NG	20,000		1	
F. glaucescens	19-28	6,500-16,000	MX	2	C2,4
F. gracilis (sometimes as F. californicus)	14-16	10,000-12,000	MX, US	2	
F. gracilis (as F. coloratus)	9-17	4,000-25,000	MX, US	3	C2
F. hamatacanthus (as Hamatocactus hamatacanthus)	18-20	9,500-12,000	MX, US	1	
F. herrerae	25	8,500	MX	1	

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
F. heterochromis (as Thelocactus heterochromis)	10-15.3	2,500-11,000	MX	3	
F. histrix	18-30	4,000-20,000	MX	2	
F. latispinus	13-24	7,500-20,000	MX	3	C1,2,3,4
F. latispinus var. flavispinus	16-20	14,000-20,000		1	
F. macrodiscus	18	15,000	MX	1	C4
F. macrodiscus var. multiflora	17	6,000		1	
F. peninsulae	23	25,000	MX	1	
F. peninsulae (as F. horridus)	24-30	12,000-20,000		1	
F. pilosus (as F. stainesii)	17-27	8,500-24,000	MX	3	C1,2,3,4 IUCN-I
F. pottsii (as Thelocactus pottsii)	12-13	6,300-10,000	MX	2	C3
F. rectispinus	17-32	8,500-20,000	MX	1	

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
F. recurvus	12.5	3,000	MX	1	C3,4 (var. greenwoodii IUCN-V)
F. reppenhagenii	9-16	6,000-23,000	MX	1	C3
F. schwarzii	24-28	16,800-22,000	MX	2	
F. uncinatus	6-13	3,000-6,000	MX, US	1	C1,4
F. viridescens	15.4-23	5,500-25,000	MX	2	
F. viridescens var. littoralis	22	15,000		1	
F. wislizeni	23-27	18,500-23,000	MX, US	1	C2
F. wislizeni (as F. emoryi)	18-27	11,000-39,000		5	
GYMNOCACTUS					Ct3,4
G. beguinii	4-5	500-900	MX	1	C3, IUCN-V

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
G. mandragora	5-6.5	1,500-2,300	MX	1	C2, IUCN-E
HOMALOCEPHALA					
H. texensis	16-23	4,500-40,000	MX, US	5	Cg1 C1,2,3,4
LOPHOPHORA					
Lophophora williamsii	4-15 9-21(F) 8-30(C)	1,000-23,000 13,000-130,000 5,500-95,000	MX, US	6	Cg1,2,3/Ct1,2 C2,3
L. williamsii var. diffusa	3.5-35	500-150,000	US, MX	3	
L. williamsii var. fricii	5-28	1,500-180,000	US, MX	3	
L. williamsii var. lutea	4-11.5 11-20(C)	1,200-15,000 5,000-33,000		3	
MAMMILARIA					
M. albicoma	3	1,300	MX	1	Cg1,3,4/Ct1,2,3,4
M. albilanata	10-11	7,500-8,500	MX	1	IUCN-V
M. aureilanata	4	1,500	MX	1	
M. candida	10	2,700	MX	2	IUCN-V
	37x38	50,000			C2

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
M. carretii (2)	31	2,000	MX	1	C3,4, IUCN-V
M. chionocephala (as M. ritteriana)	24-33	15,000-28,000	MX	1	C2
M. dixanthocentron (as M. celsiana)	28-33	18,000-23,000	MX	1	C2,4, IUCN-V
M. formosa (as M. microthele)	7-30 14F	2,000-35,000 35,000	MX	5	C3
M. geminispina (as M. leucocentra)	23	6,800	MX	1	C3,4
M. glassii	3-6	1,000-1,800	MX	1	C1,2,4, IUCN-R
M. guelzowiana (2)	34	30,000	MX	1	C3, IUCN-V
M. hahniana (2)	7-9	2,500-3,000	MX	1	C3,4, IUCN-V
M. hahniana (as M. saetigera)	38	28,000	MX	1	
M. humboldtii	3-5	1,200-1,600	MX	2	C1,2, IUCN-V
M. lasiacantha	1.9-3.5	800-3,200	MX, US	3	C3,4
M. lenta	14-21	3,200-14,000	MX	3	C1,2,3,4, IUCN-V

Table 7

Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
M. magnimamma	20-47	10,000-45,000	MX	1	C3
M. (as M. centricirrha)	18	6,500	MX	1	C2,4, IUCN-R
M. nana	22-NG	14,500-30,000	MX	2	C2,3, IUCN-R
M. parkinsonii	11	4,000	MX	1	C3,4, IUCN-R
M. pennispinosa	25-33	9,000-28,000	MX	3	C3,4
M. perbella	6	3,500	MX	1	C3,4
M. rhodantha (2) (as M. pringlei)	3.7-19	2,500-7,500	MX	4	C1, IUCN-I
M. schwarzii	3.5-11	1,000-6,000	MX	1	C2, IUCN-V
ORTEGOCACTUS O. macdougallii	3.5-7	2,200-4,800	US	1	Cg1/Ct4
PEDIOCACTUS P. simpsonii	9-15	8,500-15,000	MX	1	
PENIOCEREUS P. greggii (2)	3.7-8	3,800-28,000	US	1	
SCLEROCACTUS S. whipplei					

Table 7
Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
STENOCACTUS					Ct2,3
S. coptonogonus (as Echinofossulocactus coptonogonus)	8-20	2,500-7,500	MX	2	C1
S. kellerianus (as Echinofossulocactus kellerianus)	7-10	500-1,400	MX	1	
S. multicostatus (1) (as Echinofossulocactus multicostatus)	6.5-10.5	2,900-8,000	MX	2	C2,3
THELOCACTUS					Cg3
T. conothelos	8-10.5	3,200-4,500	MX	3	C2,3
T. hexaedrophorus var. fossulatus	7-15 30(F)	1,200-8,500 32,000	MX	6	C1
T. lophothele (?)	12-20	2,500-8,800	MX	2	
T. macdowellii (as Echinomastus macdowellii)	7	2,500	MX	1	IUCN-R

Table 7
Wild-collected Appendix II North American Species Offered for Sale in Japan, January 1982-March 1984

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
T. rinconensis (as T. nidulans)	10-21	2,200-10,000	MX	6	C2

Key

Species
(?)-Species not listed on Wildlife Trade Monitoring Unit Taxatab
(2)-Species only identified in second catalogue survey, January 1985 - March 1986 (average dollar/yen exchange rate for 1/85-3/86: $1=215 yen)

Size
cm=Centimeters
(C)=Clump
(F)=Fasciated
NG=Not Given

Price
Yen=Japanese Yen
1=Average dollar/yen exchange rate for 1/82-3/84: $1=239 yen

Country Codes
MX=Mexico
US=United States

Table 8

Wild-collected Appendix II South American Species Offered for Sale in Japan, January 1985-March 1986

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies (out of seven)	Comments
BORZICACTUS					Ct2,3,4
B. celsianus	10-13	14,500-18,800	BO, PE, CL	1	C3
COPIAPOA					Ct2,3,4
C. aureispina	7-9.5	3,500-6,500	CL	3	
C. chanarelensis	7	3,500	CL	1	
C. cinerea	7-36	3,000-75,000	CL	1	C3
C. cinerea (as *C. carrizalensis* var. *gigantea*)	15.5-17	20,000-23,000	CL	1	
C. cinerea var. *columna alba*	6-10.5	1,800-10,000	CL	4	
C. cinerea var. *dealbata*	6-10	3,000-7,000	CL	3	
C. cinerea var. *haseltonia* (as *C. haseltonia*)	8.5-14	4,000-16,500	CL	2	
C. cinerea var. *uhligiana*	34-38	4,500-7,500	CL	1	
C. de copiapo (?)	4.5-7	1,000-3,200	CL	1	

Table 8

Wild-collected Appendix II South American Species Offered for Sale in Japan, January 1985-March 1986

Genus Species	Wild-collected Size	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
C. desertorum	7.5	4,000	CL	1	
C. fiedlerana (as C. vallenarensis)	7.5	3,000	CL	1	
C. krainziana	6-9	3,500-5,800	CL	2	
C. pepiniana	7	3,500	CL	1	
C. rupestris	7	3,500	CL	1	
C. tigrillo (?)	7-8	6,000-7,000	CL	1	
DISCOCACTUS					Cg2
D. arakneispinus (?)	6.3-6.8	4,500	BR	1	
D. hartmannii (as D. magnimammus)	8-9	6,000	BR	1	C4
D. hartmanni (as D. magnimammus var. bosutensis)	7-11	6,000-8,500	BR	1	

Table 8

Wild-collected Appendix II South American Species Offered for Sale in Japan, January 1985-March 1986

Genus Species	Wild-collected[1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
D. heptacanthus (as D. cephaliaciculosus)	15-19.8	14,000-17,000	BR	2	
D. heptacanthus (as D. estevesii)	9-12	7,000-10,000	BR	1	
D. heptacanthus (as D. ferricola)	7-9	6,000-7,000	BR	1	
D. heptacanthus (as D. goianus)	10-13	10,000-12,000	BR	1	
D. heptacanthus (as D. griseus)	9-10.5	6,000-7,000	BR	1	
D. heptacanthus (as D. nigrisaetosus)	12-17.2	10,000-16,000	BR	2	
D. heptacanthus (as D. semicampaniflorus)	8-10	7,000-8,000	BR	1	

Table 8

Wild-collected Appendix II South American Species Offered in Japan, January 1985-March 1986

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen) [1]	Distribution	No. of Companies	Comments
D. heptacanthus (as D. silicicola)	7-9	6,000-7,000	BR	1	
D. horstii	6.5-7.5	5,300-5,800	BR	1	C4
D. mutuensis	8-9	6,500	BR	1	
D. placentiformis	8-13.7	7,500-10,000	BR	2	
D. placentiformis (as D. bahiensis)	6-10	4,500-7,500	BR	1	
D. placentiformis var. gigantea	14.8-18.2	11,000-19,500	BR	2	
D. placentiformis (as D. insignis)	8-18	6,500-14,000	BR	2	
D. placentiformis (as D. pulvinicapitatus)	13-21	12,000-27,000	BR	2	
D. placentiformis (as D. subviridigriseus)	10-12	8,500-9,500	BR	1	
D. zehntneri	8-10	6,500-9,000	BR	2	

Table 8

Wild-collected Appendix II South American Species Offered for Sale in Japan, January 1985-March 1986

Genus Species	Wild-collected [1] Size (cm)	Price (yen)	Distribution	No. of Companies	Comments
D. zehntneri (as D. arauneispinus)	7-8.5	7,000-7,300	BR	2	
D. zehntneri (as D. boomianus)	8.3-8.5	4,500-5,300	BR	1	
D. HU 526 (?)	13.7-15	9,000-10,500	BR	1	
D. HU 542 (?)	16	13,000	BR	1	
D. HU 543 (?)	11.5-13.7	8,000-10,000	BR	1	
D. HU 585 (?)	16.2-19.6	14,500-20,000	BR	1	
D. HU 587 (?)	17.7-20.4	18,000-24,000	BR	1	
D. HU 588 (?)	14.7-18.7	12,500-19,000	BR	1	
D. HU 589 (?)	13.9-15.4	9,500-11,500	BR	1	
D. HU 631 (?)	15-17.8	12,000-18,000	BR	1	
D. HU 632 (?)	11.8-13.5	8,500-9,500	BR	1	
D. HU 633 (?)	16-19.2	12,000-18,000	BR	1	
D. HU 640 (?)	20.2-24	23,000-30,000	BR	1	
D. HU 641 (?)	15.5-21.3	11,500-23,000	BR	1	

Table 8
Wild-collected Appendix II South American Species Offered for Sale in Japan, January 1985-March 1986

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen)[1]	Distribution	No. of Companies	Comments
ERIOSYCE					
E. ceratistes	7-12	3,800-8,900	CL	1	Cg3
GYMNOCALYCIUM					
G. cardenasianum var. horridispinum	7-10	4,000-7,000	BO	1	Cg4, Ct1,4 C3
G. eytianum	9-10	3,500	BO	1	
MELOCACTUS					
M. azureus	13.7	6,500	BR	1	Cg1,2,4/Ct1,2 C1
M. conoideus	14	7,000	(?)	1	
M. fortalezensis (?)	14	6,500	PE	1	
M. levitestatus	19	16,500	(?)	1	
M. peruvianus (as M. unguispinus)	14	3,500	PE	1	
M. HU 517 (?)	18	18,000	(?)	1	

Table 8

Wild-collected Appendix II South American Species Offered for Sale in Japan, January 1985-March 1986

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen)[1]	Distribution	No. of Companies	Comments
NEOPORTERIA					Ct4
N. curvispina (as N. grandiflorens)	7-9	2,800-4,300	PE	1	
N. islayensis var. minor	4-5	2,000-3,800	PE	1	C3
N. islayensis (as N. maritima)	6-7	2,500-3,500	PE	1	
N. krainziana var. longispina	8	6,500	PE	1	C2,3
N. unguispina (?)	5.5-6.5	2,500-3,500	PE	1	
RODENTIOPHILA					
R. lutispina var. solaris (?)	10.7	8,500	CL	1	
STETSONIA					
S. coryne	47-60	32,000-38,000	AR	1	
UEBELMANNIA					

Table 8:
Trade in Wild-collected Appendix II South American Species,
January 1985-March 1986

Genus Species	Wild-collected Size (cm)	Wild-collected Price (yen)[1]	Distribution	No. of Companies	Comments
U. ammothrophus (?)	6-10.2	8,500-18,000	BR	2	
U. buiningii	3.5-6.6	4,000-6,000	BR	2	
U. flavispina	6.8-8	8,000-12,000	BR	2	
U. gummifera	6-10.5	6,500-20,000	BR	2	
U. meninensis	5-8.2	6,000-11,500	BR	2	
U. meninensis var. rubra	6-11	6,500-18,000	BR	2	
U. pectinifera	3.5-11.8	3,500-32,000	BR	2	C4
U. pectinifera (as U. pseudopectinifera)	7.7	8,500	BR	2	
U. warasii	5-8	6,000-8,000	BR	2	
U. HU 642 (?)	7.9-8.6	10,000-14,500	BR	2	

Key

Species
(?)=Species not listed on WIMU Taxatab

Size
cm=Centimeters

Price
Yen=Japanese Yen
[1]Average dollar/yen exchange rate for 1/85-3/86: $1=213 yen

Distribution
(?)=Distribution unknown or not given

Country Codes
AR=Argentina
BO=Bolivia
BR=Brazil
CL=Chile
PE=Peru

Comments
Cg1=Trade identified at genus level reported in CITES annual report data for 1981: Cg2=1982, Cg3=1983, Cg4=1984.
Ct1=Trade in other Appendix II species of this genus not found in catalogue survey reported in CITES annual report data for 1981: Ct2=1982, Ct3=1983, Ct4=1984.
C1=Trade in this species reported in CITES annual report data for 1981: C2=1982, C3=1983, C4=1984.

IUCN Categories
E-Endangered
V-Vulnerable
R-Rare
I-Indeterminate
K-Insufficiently Known

International Trade in Succulent Plants: An Analysis of U.S. Fish and Wildlife Service Data

Katharine McCarthy*

Introduction

The peculiar, fleshy forms and, in some species, the appealing flowers of succulent plants attract collectors worldwide. While some collectors attempt to obtain every species of single group, such as a genus of cactus, others simply want a few unusual houseplants. Most succulents are native to the arid regions of the Americas and Africa, with few species native to Europe and Asia. This may explain the fascination with succulents that Europeans and the Japanese demonstrate. Trade data reveal that Japan and European countries annually import hundreds of thousands, perhaps millions of succulent plants. Although many cacti are native to the U.S., over a million cacti plus a great variety of other succulents are annually imported to the United States.

Recognizing the potential detrimental effects of extensive commercial trade in wild succulent plants, the countries party to The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) included many succulents on Appendix II. All species of the following families and genera were listed on Appendix II in 1973: Pachypodium (Apocynaceae), Cactaceae, Didiereaceae, succulent Euphorbiaceae, Aloe (Liliaceae), and Anacampseros (Portulacaceae). At each biennial meeting of the CITES member countries since 1977, either more succulents were added to the Appendices or increased protection was afforded to succulents by "uplisting" species from Appendix II to Appendix I**. Succulent species of ten plant families are currently protected by CITES.

The U.S. Department of the Interior (U.S. Fish and Wildlife Service or USFWS) and the U.S. Department of Agriculture (Animal and Plant Health Inspection Service or APHIS) cooperate in gathering and maintaining records of U.S. imports, exports, and reexports of plants listed on CITES. These data, published annually by the USFWS, were the main source for the following summary and analysis of international trade in succulent plants from 1980 through 1984 (USFWS, Federal Wildlife Permit Office 1980, 1981, 1982, 1983, 1984). Unpublished data concerning international plant trade in succulents from 1977 through 1979 gathered by the staff of the International Convention Advisory Commission of the USFWS were also used. Other available sources of data, including U.S. Customs Service statistics and APHIS plant sanitary inspection records, were not consulted because they did not provide

*The author's current address is Rutgers University, Department of Biological Sciences, P.O. Box 1059, Piscataway, New Jersey 08854.

**With the recent changes in the CITES appendices, Rhipsalis spp. and pads of Opuntia spp. are no longer covered.

sufficient plant identification. Only a few of these records identified plants to the family level so it was impossible to determine which of the traded plants were protected by CITES.

The inaccuracies and inadequacies of the USFWS CITES annual report data are discussed in the text for each succulent plant family. In general, these problems include incomplete reporting (by CITES permittees and APHIS port inspectors) of species identification, plant source (field collected vs. artificially propagated), number of plants shipped, countries of origin and destination; also, it is impossible to determine the extent of illegal trade in protected succulents. Programs were initiated in 1982 to train APHIS port inspectors in CITES reporting requirements, species identification and the determination of plant source. Great improvement in reporting is evident from 1980 through 1984; however, continuing inadequacies in reporting are abundant and necessarily limit the trade analyses of these families.

Trends in U.S. imports and exports/reexports are discussed for the succulent genera of seven families listed on CITES. (In some cases no reexports were reported so no discussion appears in the text.) These families include the six previously mentioned as having been protected since the early years of CITES plus the Asclepiadaceae (Ceropegia spp.). Species newly listed on CITES in 1983 are not included because there are few available trade data concerning these species: Agave species (3 spp.), Dudleya species (2 spp.), Fouquieria species (3 spp.), and Lewisia species (4 spp.). For the six families excluding the Cactaceae, trade data from 1977 through 1984 are discussed and 1980-1984 trade statistics presented (Table 1). Emphasis in the trade analysis of all families was placed on those taxa considered Endangered, Vulnerable, Rare, Indeterminate, or Insufficiently Known by the International Union for Conservation of Nature and Natural Resources (IUCN); taxa falling within these categories are generally referred to as "Rare" in the text of this paper. Since data concerning international cactus trade from 1977 through 1979 were presented previously (McMahan, 1981), discussion of trade in cacti is limited to data reported from 1980 through 1984. It is hoped that the detailed review provided for each family will assist government officials and conservationists in reviewing CITES species listings.

Liliaceae

Aloe is the sole succulent genus of the Liliaceae protected under CITES. The entire genus is listed on Appendix II and five species are listed on Appendix I*. Approximately 180 species have been identified in this chiefly South African genus, though few species have been reported in international trade. There is enormous variability in habit among Aloe species, making them an appealing group to collect. The spectacular foliage of perennial aloes often decorates warm climate gardens. In cool climates, the attractive rosettes of smaller species of Aloe are

*CITES no longer covers separate leaves and parts and derivatives of naturalized or artificially-propagated Aloe vera.

favored as houseplants. Aloes are commonly propagated by offsets, cuttings, and seeds (McDonald, 1976; Jacobsen, 1977).

Imports

In 1984, reported U.S. imports of aloes were four times the number reported in 1980 (Table 1). Imports of whole aloe plants continuously increased from approximately 3,250 plants in 1981 to 94,000 plants in 1984. Most of the 1980 import data do not provide sufficient information to determine whether shipments included cuttings, seeds, or whole plants. From 1981 through 1984, however, reported imports were almost exclusively comprised of whole plants, rather than plant parts. Most of the aloes were shipped from the Dominican Republic. Approximately 3,000 plants originated in Brazil and South Africa.

From 1980 through 1984 reported imports identified by species were almost exclusively of the easily-propagated Aloe barbadensis, commonly called aloe vera, the source of a liquid extract used as a moisturizer in commercial hair and skin lotions. Species identification of imported aloes has been erratic, however. While the species of most imported aloes were identified in 1980, many aloes imported from 1981 through 1984 were identified only to genus. Just 12 plants imported in 1981 were identified by species. In 1982, approximately half of all imported aloes were identified only to the genus. Of the whole plants imported in 1983, sixty percent were identified only by genus. There has been little overall improvement in the identification of imported aloes. Tens of thousands of plants continue to be imported without species identification; this is unacceptably high, especially for a genus that includes five species on Appendix I. Import shipments accompanied by CITES documentation lacking species identification should not be allowed entry.

Exports/Reexports

Aloe exports from the U.S. vary dramatically from year to year, showing no continuous trend. Just 300 plants, all identified only to genus, were reported as exports in 1980 (Table 1). Records for 1981 show exports of thirty times that number, nearly all of Aloe barbadensis (This figure does not include two shipments reported by weight rather than by number of plants.) Reported exports of whole plants dropped to average just 7,800 plant annually from 1982 through 1984. Sixty percent of the 1982 aloe exports were of A. barbadensis. Aloe striata, A. longistyla, plus a hybrid comprise most of the other aloes exported in 1982. Ninety percent of the aloe exports in 1983 were of A. barbadensis. Species identification of aloe exports from 1981 through 1983 was more complete than the identification of imports during the same period.

Accompanying the 1982 decline in whole plant exports, there was a sharp increase in reported exports of A. barbadensis plant parts, predominately comprised of cuttings, although no exports of aloe plant parts were reported for 1983. No reexports of aloes were reported in 1984.

Source

Nearly all reported trade in aloes from 1980 through 1984 involved commercial shipments of artificially-propagated plants or plants of unknown source. Since 1980, U.S. CITES records show total imports of just six wild plants, plus a single import shipment of an unspecified number of wild plants (all reported in 1983). No reexports of wild aloes were reported from 1980 through 1984. Aloe barbadensis farms in the southwestern U.S. produced many of the exported plants and cuttings. While all aloe exports were identified as artificially propagated, the source was not reported for over half of the aloes imported from 1980 through 1984. Most of the 1980 import records did not identify the source of the aloes. Reporting of the sources of imported aloes improved from 1981 through 1983; however, most of the plants were identified as artificially propagated. These plants were shipped from the Dominican Republic for the most part. Again in 1984, nearly all of the U.S. aloe imports originated in the Dominican Republic but the source was not reported for most of the 94,000 specimens. The reason for this negligence is not known. It is important that the reporting of plant source improve to its former level so that biologists and government officials may assess the impact of trade on wild populations.

Rare species

The analysis of trade in rare species of Aloe is limited by inadequate identification of imported plants. Thousands of aloes imported into the U.S. each year were reported only to genus. These shipments may have included rare species, but it is impossible to include them in this analysis since specific information is unavailable.

The few import records that do provide species identification do not include rare species. From 1980 through 1984, all of the reported exports of rare aloes were identified as artificially propagated. The number of reported exports of rare Aloe species jumped from eight in 1980 to approximately 30 in 1981 and remained between 25 and 30 species in 1982 and 1983. The number of exported plants of rare species has remained fairly constant at 5-10 plants per year.

Apocynaceae

The Apocynaceae includes numerous genera of economic importance, from Thevetia, which produces cardiac glycosides, to the ornamental species of oleander (Nerium) and periwinkle (Vinca and Catharanthus) (Wilkinson, 1978). Pachypodium, the only genus of this family protected under CITES (the genus on Appendix II, one species on Appendix I) contains just 13 species, all occurring in southern Africa and Madagascar (Jacobsen, 1977). These thorny succulents are diverse in habit, ranging from the tall tree-like P. geayi to shrub-like P. rosulatum to the prostrate P. brevicaule. All species of Pachypodium are popular among succulent

collectors and most appear in U.S. CITES trade records. Due to their limited distribution and rarity, these plants sell for high prices.

Imports

Reported U.S. imports of Pachypodium averaged about 1,100 plants per year from 1979 through 1984, with a high of 2,030 plants in 1981 and a low of about 320 plants in 1982. These data exclude 12 undescribed import shipments of Pachypodium species reported from 1979 through 1982. A total of just 80 plants were reported imported in 1977 and 1978. The import trade is almost exclusively in whole plants, with less than one percent of imports identified as cuttings. This is as expected, since most Pachypodium species are propagated only by seed (Jacobsen, 1977).

From 1977 through 1983, the majority of imports of Pachypodium plants were identified only to the genus. Nearly all of these unidentified imports originated in Madagascar, the country to which several Pachypodium species are endemic. A total of 17 species and varieties was identified among the plants imported from 1979 through 1983. Of these identified taxa, P. brevicaule was most commonly imported (580 plants), followed by P. rosulatum (114 plants). Species identification of imported plants has improved since 1979 but remains extremely inadequate. Improvement in species identification is essential since most imports are from countries to which the plants are native and the genus includes the extremely rare P. namaquanum (Appendix I) from South West Africa which may be shipped with other unidentified Pachypodium plants.

Exports/Reexports

The U.S. reportedly exported far fewer Pachypodium specimens than it imported from 1977 through 1984. No U.S. exports were reported in 1977 and 1978 and only a single specimen was reported in 1979. In the following years, exports averaged about 100 plants per year. From 1980 through 1984, the largest number of exports occurred in 1984 (259 plants) and the least occurred in 1982 (38 plants). All reported exports were of whole plants.

Identification of exported Pachypodium species has been far more thorough than identifications of imports. Few exported plants have been reported only to genus; in 1983 all exported plants were identified to species. The number of species reported among exports remained fairly constant from 1981 through 1983.

Source

Most of the Pachypodium specimens reported in U.S. trade from 1980 through 1983 were identified as artificially propagated. This includes many plants imported to the U.S. from Madagascar and southern African nations. Although some growers in Madagascar reportedly collect wild plants and pot them for sale as artificially propagated specimens, it appears that local propagation has

significantly increased in recent years. In addition, nurseries in Europe and in the southwestern U.S. have stepped up propagation of Pachypodium species. Several of these species are reportedly easy to cultivate and fast growing. With this increased supply of less expensive, artificially-propagated plants, the assault on wild plant populations may be declining. Propagation of Pachypodium species contributes greatly to the conservation of wild populations, and the nurseries involved deserve recognition and support.

Rare species

Pachypodium namaquanum, listed on Appendix I in 1981, appeared in U.S. CITES commercial trade records only in 1981 and 1982. A total of 26 plants were reported, nearly all of which were imported from South Africa. 1981 sources for imports were not identified but all 1982 imports were reported as artificially-propagated plants. It is impossible to draw any conclusions concerning trade in rare species because most of the imported Pachypodium plants were not identified by species.

Didiereaceae

This small family of succulents is endemic to Madagascar. The four genera of Didiereaceae include a total of 11 species, all protected under CITES Appendix II. Due to their rarity, these bizarre species are treasured by succulent collectors. All species of this family are reported in U.S. CITES trade records. The current classification scheme divides the family into the genera: Alluaudia, Alluaudiopsis, Decaryia, and Didierea.

The six species of Alluaudia are arborescent and shrub-like, ranging from six to twenty meters in height. Morley (1978) describes A. procera as, "a bent and thorny telegraph pole up to 15 m high, with flowers produced in incongruous apical clusters." Alluaudia species may be propagated by seeds and cuttings.

Two shrub-like species of Alluaudiopsis are known. Both are dioecious perennials, 2-4 m tall, producing large white (A. fiberensis) or crimson (A. marnierana) flowers. These species may be propagated by seeds and cuttings.

Decaryia is a monotypic genus. The single species, D. madagascariensis is a straight-stemmed perennial, 6 to 8 m tall, with thorny zig-zagging branches. It is reported to be propagated by seeds and cuttings.

The two species of Didierea are tree-like and thorny similar to some euphorbs. Both species produce small, deciduous leaves. D. madagascariensis is columnar in form with erect branches. D. trollii initially spreads horizontally, producing an immature, shrub-like form. Erect branches grow from this immature form and horizontal branches arise from these. The basal branches eventually die. Both species may be propagated by seeds and cuttings.

Imports

Alluaudia: Imports of specimens of Alluaudia were reported for just four years: 1978 and 1982 through 1984. The 44 plants imported in 1978 were of A. dumosa and A. procera. In 1982 just six plants were imported, two of A. ascandens and four of an unidentified species. Imports increased in 1983 and 1984. A total of 200 plants was imported during both years, primarily from Madagascar and the Federal Republic of Germany (F.R. Germany). Most of these imports were of A. ascandens. All imports were reported to have been commercial shipments of artificially-propagated plants (excluding four specimens of unknown source). There were no reported imports of seeds or cuttings.

Alluaudiopsis: The only imports of specimens of this genus were reported in 1978. Nine specimens of A. marnierana were imported to the United States. There is no record indicating whether these plants were artificially propagated or field collected.

Decaryia: There were no reported imports of Decaryia from 1977 through 1984.

Didierea: According to CITES records, this is the most commonly imported genus of the family. Most of the plants reportedly originated in Madagascar and F.R. Germany. Although there are no records of imports from 1977 through 1979, 110 plants of unidentified species of Didierea were imported from Madagascar in 1980. In 1981 and 1982 a total of just five plants were reported as imports. Total imports for the genus rose in 1983 to 238 plants, nearly half of which were not identified by species. The identified plants were all of D. madagascariensis. Imports dropped to 67 plants in 1984. All import records were of commercial shipments of artificially-propagated plants (excluding two plants of unknown source). No imports of cuttings or seeds were reported.

Exports/Reexports

Alluaudia: Although no exports were reported for this genus from 1977 through 1979, 79 plants were reported to have been exported from 1980 through 1984. These exports were fairly evenly distributed over the five years, although they declined somewhat after 1981. Although none of the plants exported in 1980 were identified by species, reporting of species for this genus was more thorough thereafter. Interestingly, the most commonly imported species, A. ascandens, was not reported among exports in any year. The four other species of Alluaudia were all reported in trade each year from 1981 through 1984. Alluaudia montagnacii was the most commonly reported species among exports of the genus. All reported exports were commercial shipments of artificially-propagated plants.

Alluaudiopsis: Exports of just 20 plants of this genus were reported from 1980 through 1984. No exports were reported from 1977 through 1979 and in 1983. The

number of exported plants consistently declined from 1980 through 1984. Only one of the ten plants exported in 1980 was identified by species, although exports in the following years were fully identified. Both species of Alluaudiopsis appeared in trade. All export records for this genus were of commercial shipments of artificially-propagated plants.

Decaryia: Exports of Decaryia madagascariensis were reported only in 1980, 1981, and 1984. Twenty plants were exported in 1980 and a total of ten plants were exported during 1981 and 1984. Export records indicate that all shipments were commercial and all plants were artificially propagated.

Didierea: Reported imports of plants of this genus greatly exceeded exports from 1977 through 1984. No exports were reported from 1977 through 1979 and in 1984. Just 33 plants were reportedly exported from 1980 through 1983; two-thirds of these were reported in 1980. Seven exported plants were identified as Didierea trollii, all others were of D. madagascariensis. Species identification was complete in all years. All exports were reported to be commercial shipments of artificially-propagated plants.

Portulacaceae

Of the Portulacaceae, the genus Anacampseros and four species of Lewisia are protected under CITES, all under Appendix II. Species of Anacampseros are native to southwestern, central and eastern Africa and southern Australia. These small perennial herbs are popular among succulent plant enthusiasts (Rowley, 1978) and are commonly propagated by both seeds and cuttings. Lewisia species occur primarily in western North America. The four species listed under CITES are native to the western United States. These species are attractive alpine and rock garden plants in great demand by hobbyists. Extensive international interest is demonstrated by active rock garden clubs and alpine garden societies in Canada, Europe, and Japan. Both field-collected and artificially-propagated specimens of the listed species are offered for sale in international plant journals. Under the pressure of unmanaged commercial exploitation, concern for the survival of the relatively few extant populations led to listing of the four Lewisia species in 1983. Since there are no published data available regarding U.S. trade in Lewisia species at the time of writing, trade in these species will not be discussed.

Imports

Fewer than 500 specimens of Anacamperos species were reportedly imported to the U.S. from 1977 through 1984. All but a few of the imported plants were from South Africa. The reported numbers fluctuated over these years. After 1981, however, the number of imported plants consistently declined; no imported specimens were reported in 1983. No imports of seeds or cuttings were reported in trade.

Species identification of the imported plants greatly improved over this period. Of the 260 plants imported in 1979 and 1980, only six were identified by

species. In contrast, all but three plants reported since 1980 were fully identified. Most of the identified imported plants were of A. alstonii, A. papyracea, and A. ustulata. Reporting of the source of these imported plants parallels species identification. The source was not recorded for those plants identified only to genus. All imports since 1981 were identified as artificially propagated. The only clear trend in imports of Anacampseros is a consistent improvement in the quality of reporting.

Exports/Reexports

Although there were no exports reported from 1977 through 1979, 214 plants were reported thereafter. All reported exports of Anacampseros species were of commercial shipments of artificially-propagated plants. Two-thirds of these exports occurred in 1981 and 1984. No exports of seeds or cuttings were reported. Species identification of exports was quite thorough until 1984, when nearly half of the exported plants were not identified by species. This negligence is unacceptable, particularly since the shipments and permits originated within the U.S. and therefore are more easily regulated than imports. The number of species and the total number of plants reported in trade nearly doubled from 1980 to 1981 but then declined until the 1984 increase. A diverse range of species was traded over all the years. Unlike other families, there does not appear to be a trend of increasing diversity of reported species in trade in response to a more specialized market. Most of the exports of Anacampseros were to the United Kingdom (U.K.), F.R. Germany, Australia, and Canada.

Asclepiadaceae

Of the several genera of Asclepiadaceae which include succulents, only Ceropegia and Frerea are protected under CITES. All species of both genera are listed on Appendix II. The succulent species of Ceropegia are chiefly native to southern and tropical Africa, India, the Canary Islands, and Madagascar. Ceropegia species are popular ornamentals in warm climates. The attractive, often bizarre foliage and flowers of this genus are especially appealing to collectors. Ceropegia woodii (rosary vine) and C. barkleyi are commonly traded houseplants. Frerea is a monotypic genus; its only species, F. indica (Caralluma frerei Rowl.), is endemic to a few isolated areas of India (Walker, 1981). Although F. indica is commonly cultivated and is offered by numerous nurseries, there is just one U.S. CITES record of trade in this species. Ceropegia species and F. indica are propagated by both cuttings and seeds (Jacobsen, 1977).

Imports

Few imported specimens of Ceropegia were reported from 1977 through 1984. A total of 17 plants were reportedly imported during this period; eleven of these were C. devecchii imported in 1977. There was no reported trade in seeds or

cuttings of Ceropegia during these years. All imported specimens were identified by species.

Exports/Reexports

Reported exports of Ceropegia species averaged 48 plants per year from 1979 through 1984, with consistently increasing exports after 1981. (There were no records of exports for this genus in 1977 and 1978.) Twenty percent of the reported exports were of cuttings, the remainder were of whole plants. These cuttings were all exported from 1982 through 1984. This increase in the export of propagules may be an indication of increasing artificial propagation of Ceropegia species.

Overall, the species identification for reported exports was thorough. In 1980, however, none of the exported specimens of Ceropegia were identified by species. These 1980 records were for several different shipments and there is no apparent reason for the repeated omissions. The number of species reported among exports consistently increased from two species in 1978 to 20 species in 1984. This may indicate a general trend of increasing interest in the unusual members of this genus.

A single reexport shipment was reported from 1977 through 1984. This 1981 record documents the commercial shipment of a single, wild specimen of Ceropegia pachystelma.

All other reported trade in this genus was of commercial shipments of artificially-propagated specimens.

There is little available information concerning the status of wild populations of Ceropegia species, although IUCN is currently accumulating information on the status of African succulents. To date, C. fusca and C. krainzii are the only species of this genus for which a determination of rarity was made. It is hoped that this information in conjunction with CITES trade data will help government officials assess species listings for the genus. A single specimen of C. fusca was reported in trade from 1977 through 1984. C. krainzii was not reported in trade.

Euphorbiaceae

Within the Euphorbiaceae, only succulent species of the largest genus Euphorbia, are protected under CITES Appendix II. Most of the approximately 500 succulent euphorbs are native to southern and eastern Africa and Madagascar, with some species occurring in India, the Canary Islands, and the Americas. Though euphorbs are quite variable in form, most are shrublike, with ribbed stems and small, short-lived, deciduous leaves. The flowers often include small, attractive, colorful bracts, though generally they are less showy than those of the poinsettia

(E. pulcherrima). There is considerable interest in this genus among succulent enthusiasts, as evidenced by the success of the recent Euphorbia Journal. While many species are easily propagated by seeds and cuttings, field-collection continues to deplete natural populations (Fourie, 1984). Horwood (1984) recommends grafting techniques for some of the rare and less readily propagated species.

Imports

Since 1977, reported imports of euphorbs have greatly exceeded exports, usually by two orders of magnitude. Total imports reported from 1977 through 1979 (1,450) were much lower than for the following years, which averaged 265,700 plants per year. This probably indicates an improvement in reporting rather than a tremendous increase in trade. A significant increase in trade apparently occurred in 1984, when reported imports totalled approximately 418,000 plants. Nearly all of the reported imports were of whole plants; approximately one percent of the imported euphorbs were cuttings.

At least two-thirds of the euphorbs imported to the U.S. were exported from the Dominican Republic. From 1979 through 1984, there was a constant decline in the reported numbers of plants imported from South Africa and Madagascar. At the same time, however, there was a tremendous increase in imports from the Netherlands and Haiti. By 1984, these two countries were major sources of imported euphorbs, after the Dominican Republic.

The species identification of imported euphorbs has become more thorough since 1980, but remains inadequate. Surprisingly, from 1977 through 1979 a greater proportion of imported euphorbs was fully identified than from 1980 through 1984. At least ninety percent of the euphorbs reportedly imported between 1980 and 1982 were identified only to genus. This proportion improved substantially in 1983; approximately fifty percent of the imported euphorbs were identified by species. While this was a significant step, there remained over 200,000 imported euphorbs of unidentified species. Also, over 1,000 of these plants were not identified by source. Further improvement in the reporting of species and sources is essential if the data are to be useful to government officials monitoring trade in rare species.

While the number among reported Euphorbia species imports remained fairly constant from 1980 through 1984 (at about sixty species per year), there was considerable variation in the species that were imported each year. In 1980, E. loricata was the most common of the reported euphorb imports (10,500 plants). E. keithii (6,000) and E. cactus (5,100) were most common among the identified 1981 imports. Of the identified 1982 imports, E. trigona was the most abundant (12,000 cuttings, 5,000 plants). Euphorbia keithii (6,000 plants) and E. hermentiana (4,500 plants) dominated the 1983 imports. In 1984, E. trigona (11,000 plants) and E. hermentiana (9,800 plants) were again the most common of the identified imports. However, over half of the euphorbs imported since 1979 were identified

only to genus; there may have been species among these unknowns that were imported in greater numbers than those listed above.

Exports/Reexports

The number of euphorbs exported from the U.S. increased steadily following the first reports in 1979. The small number of plants reportedly exported in 1979 (307) probably reflected inadequate reporting. From 1980 through 1982 the reported exports of euphorbs remained fairly constant at 2,500 plants per year. This figure more than doubled in 1983 and over 5,000 euphorbs were reported among the 1984 exports. This increase is probably a reflection of increased commercial interest in this genus. Nurseries in the southwestern U.S. are stepping up propagation of euphorbs to satisfy the growing national and international market. Over half of these plants were exported to F.R. Germany, and one fourth were exported to Canada, Japan, and the United Kingdom.

Species identification of exported euphorbs increased markedly after 1980. Less than one percent of the euphorbs exported in 1980 were fully identified, including just 26 species. In 1981, nearly all of the exported euphorbs were identified by species, comprising nearly 200 species. Approximately 200 species of Euphorbia were reported among the exports from 1981 through 1984, while just 60 species were reported among the imports of that period. Each year since 1979, E. mammillaris was the most commonly exported species. Following this species in quantity were E. candelabrum, E. millii, E. obesa, and E. flanaganii.

Just six specimens of Euphorbia were reexported from the U.S. from 1980 through 1984. Originating in South Africa, these plants were shipped to the U.S. and then to Europe. All were reported to be field-collected plants except one of unknown source.

Source

Few of the euphorbs in trade were identified as field-collected plants. All U.S. exports were reported to be artificially-propagated plants. Just 56 of the 1,325,775 euphorbs imported from 1980 through 1984 were recorded as field-collected specimens. Of the euphorbs imported from 1980 through 1983, the source was not reported for approximately 25,000 plants. The source was not reported for most of the euphorbs imported in 1984. The reason for this negligence is not known. Improvement is imperative if the trade data are to be useful in assessing the impact of commercial trade on CITES-listed species.

Rare species

U.S. records from 1980 through 1984 show trade in over twenty species of Euphorbia determined to be rare by botanists of IUCN. The number of rare species appearing in trade has increased consistently since 1980. Several hundred specimens

of rare euphorbs were reported in trade during this period. Although many of these rare specimens are reportedly slow growing and extremely difficult to cultivate, nearly all of the plants in trade, including both imports and exports, were identified as artificially propagated. This raises doubt as to the validity of source reports in both U.S. and foreign documentation.

Cactaceae

The entire family Cactaceae, including perhaps 2,000 species, is protected by CITES (with the exception of Rhipsalis spp. and pads of Opuntia spp.). The genus Turbinicarpus plus 34 other species of cacti are listed on Appendix I. Almost exclusively indigenous to the New World, members of the Cactaceae occur over an extensive portion of both North and South America. The distribution of cacti extends from British Columbia and Alberta, Canada south to Patagonia, and from the Galapagos Islands east to Cape Cod, Massachusetts. North American species are concentrated in the southwestern U.S. and arid portions of Mexico. Several species of the genus Rhipsalis are believed to be native to southern Africa, Madagascar, and Sri Lanka; species of Opuntia introduced to other regions have become naturalized (Benson, 1982; Backeberg, 1976; Hunt, 1967).

With the possible exception of orchids, cacti are probably the most heavily commercially exploited plant group in ornamental plant trade. The great variety of bizarre forms that occurs in the family, from tropical epiphytes to the pincushions of arid regions, has attracted collectors worldwide. Most international trade is in very small plants, although large cacti are shipped within the U.S. and from Mexico for use in landscaping.

Reported trade between U.S. and Mexico has declined dramatically since the late 1970's, although the U.S. still imports tens of thousands of field-collected cacti each year. This extensive trade in field-collected Mexican cacti has raised concern for the status of wild populations. In 1983, ten species and one genus of cacti endemic to Mexico were added to Appendix I, affording greater protection to these species. Trade in Mexican and U.S. cacti will be discussed further, first within the general analysis of trade in the Cactaceae which follows, then in the section concerning North American cacti. Trade in 17 selected genera of both North and South American cacti will be discussed following the general family trade analysis.

Imports

Over one million imported cactus cuttings and plants were reported each year from 1980 through 1984 (Table 2). In 1980 and 1981 there were at least 30 shipments identified as including unknown quantities of cacti. Therefore imports in these two years must be underestimated. Such negligence has not occurred since, except in very few cases with unidentified shipments arriving from Brazil, South Africa, Mexico, and Chile. Reported imports declined significantly in 1982, when a

drop of at least 450,000 plants was reported. This trend did not continue. In 1984 reported imports exceeded reported imports for all other years. However, due to inadequate reporting of plant quantities in 1980 and 1981, it is impossible to determine if the 1984 imports did exceed the actual numbers imported during those years.

Japan was the chief source of U.S. cactus imports, followed by Brazil, the Dominican Republic, Mexico, and the Netherlands. Approximately one-third of the cacti reported among U.S. imports from 1980 through 1984 were shipped from Japan. The 1982 decline in total U.S. cactus imports appears to have resulted from a tremendous decline in imports (of about 435,000 plants) from Japan. The cause of this temporary decline is unknown. In 1983 and 1984 imports from Japan increased to their former quantities. U.S. imports from Brazil nearly equalled the imports from Japan from 1980 through 1984. The numbers of plants imported from Brazil in 1980 and 1981 must be underestimated due to inadequate reporting of at least 20 shipments from that country. Recent reports indicate that U.S. imports from Brazil exceeded imports from Japan in 1984. Approximately 20 percent of the cacti imported from 1980 through 1984 originated in the Dominican Republic. Reported imports from this country have declined since 1980 and in 1984 cactus imports from the Dominican Republic comprised 15 percent of the total U.S. imports. Approximately 800,000 plants imported to the U.S. from 1980 through 1984 came from Mexico. About 400,000 of these were imported in 1980. U.S. imports from Mexico then declined to approximately 100,000 plants in 1983 and about 80,000 plants in 1984. Recently, the Netherlands became an important source of cacti to the U.S., supplying about 185,000 plants in 1983 and roughly 72,000 plants in 1984.

While it seems likely that most of the cacti imported to the U.S. from Japan and the Netherlands were artificially propagated, as reported, the sources of cacti imported from Brazil and the Dominican Republic are open to question because they are frequently not reported. This is particularly alarming since cacti are native to both countries. Reporting of the source of cacti from Brazil is especially poor. Most plants imported in 1980 and 1981 were reportedly artificially propagated. Since then, however, nearly 1,300,000 plants were imported to the U.S. with no reported record of the source. The reason for this negligence is not known. Brazil is within the range of many species of South American cacti and it is quite possible that many of the U.S. imports from Brazil are field-collected plants. The impact of such commercial exploitation on native populations could be significant. It is essential that reports of these imports include the source of the plants so that potential impacts may be considered by biologists and government representatives.

Cacti imported from the Dominican Republic were identified exclusively as artificially propagated until 1984, when sources were not reported for any of the roughly 200,000 cacti imported. It is unclear why the sources of so many plants were not reported. There have been reports that some commercial cactus growers in

Central and South America (and North America) do not distinguish between cacti that they have propagated from seeds and cuttings and field-collected cacti that they have simply repotted. Therefore, plants shipped with the authorization of a certificate of artificial propagation may include field-collected plants. This presents a difficult problem which requires investigation.

There is no question that cacti imported to the U.S. from Mexico were virtually all field-collected plants. There is very little commercial artificial propagation of cacti in Mexico and the 1981 through 1984 data show that almost all of the cacti imported to the U.S. from Mexico were reported as wild or of unknown source. None of the 1980 records indicated the source of Mexican imports.

Since 1980, most of the trade in cacti has been in whole plants. The exception to this pattern occurred in 1982, when approximately one-third of the cactus imports were identified as cuttings. It is difficult to assess the international trade in cactus seeds due to the several seed reporting methods; seeds are reported in ambiguous units such as number of envelopes, mass, or simply records that a shipment of seeds occurred. These various reports declined after 1981 and no reports of cactus seed imports were made in 1984. Although this appears to indicate a decline in seed imports, it may be a reflection of changing policies concerning reporting requirements. Prior to August 1985, most trade in parts and products of plants listed on Appendix II of CITES was not monitored. If seeds were considered by port inspectors to be plant parts, then the inspectors would not report their import. It is impossible to draw any conclusions from the few data that are available.

Species identification of reported imports of cacti continues to be extremely inadequate. Hundreds of thousands of plants imported from 1980 through 1984 were identified only to the family, Cactaceae. There has been some improvement since 1980, when 75 percent of the imported cacti were identified only to family. The proportion of unidentified cacti dropped to 60 percent of all cacti imported in 1981 and 1982, to 40 percent in 1983 and 35 percent in 1984. Identification of cacti to the genus level is also common in all years. While this is certainly an improvement over family level identification, it provides a method for avoiding Appendix I trade restrictions since it allows importers to mix Appendix I species with shipments of more common species of the same genus. Complete identification of imported cacti is essential to achieve the purposes of CITES.

While there has been improvement in the species identification of imported cacti, there has been an increase in the reported number of taxa of imported cacti. Approximately 200 taxa were identified among 1980 imports, but over twice that number — about 430 taxa — were reported in 1984 import data. Vast numbers of unidentified imports make it impossible to determine whether the increased number of species actually reflects increased specialization in the commercial trade, or simply improved species identification practices.

Exports/Reexports

From 1980 to 1984, far fewer cacti were exported each year from the U.S. than were imported (Table 2). While cactus imports averaged over one million plants annually, exports averaged close to 70,000 plants per year. Half of all exports during these five years occurred in 1980 and 1984. In the intervening years, exports ranged from approximately 10,000 to 50,000 plants per year. The reason for this difference is not known. During the five year period, there were very few export reports that identified the quantity of cacti only by shipment. These data, therefore, are more reliable than the import data.

F.R. Germany has been the major consumer of U.S. cacti, receiving one-third of all reported cacti exported from the U.S. during the five-year period, from 1980 through 1984. Exports to other countries were less consistent over this period. Few plants were shipped to Denmark in 1980, 1981, and 1983, but 50 percent of the 1982 reported cactus exports and 60 percent of the 1984 exports were shipped to Denmark. Only in 1981 and 1983 was Switzerland a chief consumer of U.S. cacti. Ten percent of the cacti exported in 1981 and 25 percent of the cacti exported in 1983 were sent to Switzerland. Although a total of 11,000 cacti was reported as exports to the Netherlands in 1980 and 1981, there were few plants shipped to this country in the following three years. Export reports indicate that Canada was an important consumer in 1982 and 1983, receiving 11,000 cacti during these years. The United Kingdom has also been an important consumer of U.S. cacti, receiving 11,000 cacti from 1980 through 1984.

From 1980 through 1984, Canada was the only non-European country of the major consumers of U.S. cacti. Nearly 50 nations imported U.S. cacti during these five years. During this period nearly one-tenth of all exported cacti had no record of the country to which they were shipped. Most of these incomplete reports were for shipments made from 1982 through 1984. Complete information is necessary to enable the countries at both ends of the shipment to compare records and to determine if there are problems with the reporting systems in either country. Improving the reporting of the destination country would require little effort on the part of the port inspectors since shipments must be obviously labeled as to the destination.

Reported exports of cactus cuttings increased from 1980 through 1984, while reported exports of seeds declined during that period. Just 18 cuttings were reported among the 1980 exports, although exports of 4,500 cuttings were reported in 1981. This number dropped to an average of about 2,400 per year in 1982 and 1983, but increased sharply to roughly 9,000 cuttings in 1984. Although seed exports totalled 20,000 seeds in 1980 (all to the U.K.), there were no reports of seed exports in 1981 and just over 400 seeds exported in 1982. The number increased markedly to almost 8,300 seeds in 1983, and then dropped to 900 seeds in 1984. All seeds and cuttings exported since 1980 were reported to have been from artificially-propagated cacti, although there apparently was a general

misunderstanding among cactus dealers as to the meaning of "artifically propagated" and the distinction between exports and reexports. Nearly half of the seeds exported in 1980 were reported to be from artificially-propagated specimens of Ariocarpus species. The species of this genus occur almost exclusively in Mexico and are very slow-growing; it is extremely improbable that thousands of seeds were taken from mature, artifically-propagated plants of this genus. These seeds were almost certainly field-collected in Mexico, and should be considered reexports of wild origin.

Not surprisingly, nearly all reported cactus exports from the U.S. from 1980 to 1984 were recorded as artifically-propagated plants. Since the U.S. Fish and Wildlife Service issued very few CITES permits authorizing the export of field-collected plants, there could have been few legal exports of wild cacti during this period. U.S. cactus dealers either sold field-collected plants within the U.S. or mislabelled them as artificially propagaged in order to export them. There have been reports that dealers opted for the second, illegal alternative in the early years of CITES implementation, though this is very difficult to investigate long after shipments have entered the country.

Prior to 1982, APHIS port inspectors were neither trained to identify cacti nor trained to distinguish between propagated and field-collected plants. The USDA, with the assistance of USFWS, developed a training program to aid inspectors with the difficult task of identification. Port inspectors originally trained to identify plant diseases and pests now are better able to enforce CITES permit and reporting requirements. Port inspector training programs must be regularly held and updated to provide the additional education needed to distinguish newly-listed species. Adequate training of these port inspectors is essential if CITES regulations are to be implemented with any success.

Species identification of exported cacti has been far more thorough than that of imported cacti. Export reports for 1980 and 1981 identified 600 plants only to the family, Cactaceae. This number dropped to 94 plants in 1982 and one export shipment in 1983. By 1984, all exported cacti were identified at least to the genus, with the exception of 1,200 hybrids. In 1984, about 134,000 exported cacti were identified only to genus. The identification of exported cacti has improved significantly since 1980, but further effort is needed both to protect those rare species listed on Appendix I and to enable government officials to assess the trade in native cacti. The next step in improving cactus identification is full identification to the species level.

Reexports

The number of cacti annually reexported from 1980 through 1984 was consistently less than the number imported or exported during this period. Reexports declined from about 33,700 cacti in 1980 to 10,600 cacti in 1984. The sharpest decline occurred from 1981 to 1982, when the number of reexports decreased

by almost 16,000 plants. This decline may reflect reduced imports of Mexican cacti to the United States. The origin of most of the cacti reexported in 1980 was not reported but it is likely that these originated in Mexico, since, from 1981 to 1984, all but 20 reexported cacti originated there. The decline also may reflect more stringent enforcement of CITES regulations requiring submission of original Mexican export documents prior to reexport. Japan, the Netherlands, F.R. Germany, Switzerland, and the U.K. were the major consumers of U.S. cactus reexports as well as exports.

Thousands of these reexported cacti were reported as artificially propagated. Since there is little commercial propagation of cacti in Mexico, these reports are highly questionable. Such reports reduce the credibility of source identification, not only for reexports, but also for imports and exports.

Most of the reported trade in cactus seeds was comprised of Mexican reexports. Reported reexports of cactus seeds declined from 283,037 seeds in 1980 to 10 seeds in 1983, and no reexports of seeds were reported in 1984. As with whole plants, thousands of reexported Mexican seeds were almost certainly field-collected but were reported as artificially propagated. From 1980 to 1984 there were few reported reexports of cactus cuttings.

While reported cactus reexports were identified to the genus in most cases, most reported cacti were not identified by species. The most common genera of the reexported cacti included Ariocarpus, Astrophytum, Mammillaria, Lophophora, and Turbinicarpus. Each of these genera includes rare species; Ariocarpus and Mammillaria contain species listed on Appendix I, while all species of Turbinicarpus are on Appendix I. It is quite possible that these rare species were among the reexported cacti. More thorough species identification of these reexports is essential to protect these rare species.

Trade in Selected North and South American Cactus Genera

While species of some cactus genera are easily propagated and cultivated, including many species of the epiphytic genera, others such as species of the globular, pincushion-shaped genera, are more difficult to propagate and cultivate. The slow-growing, globular cacti, particularly those that occur in South America, deserve further investigation and greater attention from conservationists and government officials than they have received. Since many of these species require several years to mature before flowering, they are very susceptible to commercial field-collection. As older flowering plants are removed from wild populations the age structure of the population shifts toward younger plants, which may suffer higher natural mortality than more mature individuals. Thus the rate of population decline may accelerate. When the flowering cacti are removed, few reproductive individuals remain, and the population may stagnate until the young plants mature. Commercial exploitation of wild populations of these cacti may be detrimental and, for rare species, may threaten not only the survival of the population but of the species.

U.S. CITES trade data concerning eight South American and nine North American genera will be discussed following a brief summary of genus characteristics. The selected genera include species that may be vulnerable to commercial trade because they are slow-growing, heavily traded, rare, or of limited distribution. The reported trade in cuttings and whole plants of each genus (excluding the few shipments reported by weight) is summarized for easy reference (Table 3).

South American Genera

Borzicactus

Species of Borzicactus vary in form from short-cylindric to procumbent-elongated. As with species of Neoporteria, short-cylindric plants develop from small, globular, juvenile forms. The stems are often multi-ribbed and spiny. In some species, the flowering areoles produce long hairs. The funnel-shaped flowers are orange to scarlet. Species of Borzicactus are native to Ecuador, Bolivia, Peru, and Chile. The analysis for this genus includes data reported for the following synonymous genera: Oreocereus, Arequipa, Matucana, Submatucana, Akersia, Hildewintera, Loxanthocereus, and Morawetzia.

Imports

Approximately 10,500 specimens of Borzicactus were imported to the U.S. from 1980 through 1984. Half of these plants were imported in 1981, and about 1,000 plants were imported in subsequent years until imports increased to 2,500 plants in 1984. Approximately 65 percent of the plants imported from 1980 through 1984 were of B. trolli, and 10 percent were of B. celzianus. A total of 15 other species accounted for the remainder of the imports. Species identification was generally thorough.

There was very little reported trade in cuttings and no reported trade in seeds of Borzicactus species. Half of the imported specimens were reported as artificially propagated and records for the remainder did not include a source. Reporting did not improve during the five-year period. Most of the 1984 imports were not identified by source. It is important that the source be identified, particularly when plants are imported from regions to which they are native.

Exports/Reexports

Nearly 12,000 specimens of Borzicactus were exported from the U.S. from 1980 through 1984. Seventy percent of these exports were reported in 1984. All exports were reported as artificially-propagated plants.

Copiapoa

With a generic name derived from the Chilean province of Copiapo, all species of Copiapoa are endemic to Chile. These species are small, cylindric, and globose in form. Their stems are ribbed and topped with dense, soft wool that conceals the flowers of some species (Britton and Rose, 1937). Some have unusually colored stems and spines, ranging from white stems with black spines to black stems with white wool. In addition, some species flower when they are fairly young. Thus the slow growth of these species does not deter collectors seeking plants that will soon flower. The data analyzed for this genus include data reported for the synonymous genus Pilocopiapoa.

Imports

Over half of the nearly 20,000 Copiapoa plants imported into the U.S. from 1980 through 1984 were reported in 1984. Most were reported to be artificially propagated from Brazil and Peru. Approximately 700 field-collected plants from Chile were reported among the imports during this five-year period. Thirty-five percent of the imported plants were not identified as to their source; half of these were probably field-collected, while the remainder from Brazil may have been artificially propagated. Nearly 10 percent of the imports were of cuttings, although no cuttings were reported among the 1983 and 1984 imports. Species identification was complete for all but seven percent of the imported plants. However, hundreds of plants of this genus continue to be imported each year with no record of the species. Copiapoa cinerea and C. tenuissima were the most common of the forty species reported in U.S. trade from 1980 to 1984.

Exports/Reexports

During the five years, 1980 through 1984, a total of 650 specimens of Copiapoa were exported from the United States. Most of these plants were exported in 1983. All exported plants were reported as artificially propagated.

Discocactus

The nine species of Discocactus are native to Brazil and Paraguay. A flattened, globular form is characteristic of this genus. The plants are usually small with a spiny, ribbed stem. All species produce a woolly cephalium, although it is not as pronounced as the cephalium of Melocactus species. The white to rose-colored tubular flowers arise from the cephalium and open only at night. All species of Discocactus are relatively rare and at least one species may be extremely rare (Innes, 1977).

Imports

There is little reported U.S. trade in Discocactus species, although they are

commonly offered for sale in international trade journals. Nearly all of the 279 imported plants of this genus reported from 1980 through 1984 were imported from Switzerland in 1980. All of the plants in trade were reported as artificially-propagated plants, except a few of unknown origin which were fairly large specimens from Costa Rica. The species identification of the imported plants has been very thorough in all years. Discocactus horstii was the most commonly imported species of the 15 Discocactus species reported in trade from 1980 to 1984. There was little trade in cuttings and no reported trade in seeds.

Exports/Reexports

Total reported exports of Discocactus species were fewer than total imports, but greater than imports during the four years, 1981 through 1984. All exports were reported as artificially-propagated plants.

Gymnocalycium

The genus Gymnocalycium is very popular among cactus enthusiasts, perhaps because it is reportedly very easy to cultivate. These low, globular plants have distinct ribs and large, funnel-shaped flowers that are particularly attractive. The generic name was derived from the Greek terms for naked bud, which describes the glabrous flower bud. Species of Gymnocalycium are distributed widely through South America in Chile, Argentina, Bolivia, Brazil, Paraguay, and Uruguay. Data compiled for this genus include plants of the synonymous genera Neowerdmannia and Weingartia (Hunt, 1967; Innes, 1977).

Imports

Gymnocalycium is one of the most commonly imported South American genera. Imports of this genus have increased, from 174,000 plants reported in 1980 to 427,000 plants reported in 1984. Most of the reported imports were of artificially-propagated plants from Japan and Brazil. Thirty-five percent of the imports had no record of their source but originated in Japan and Brazil. The reporting of the source of these cacti worsened after 1980; nearly 300,000 plants in 1983 and 93,000 plants in 1984 were not identified by source. During the five-year period, 175 imported plants were reported as field-collected. Thousands of imported specimens of Gymnocalycium are annually reported only to the genus, although this represents just two percent of all imports of this genus. Most common among the imported species were G. mihanovichii (native to Paraguay) and its cultivars, G. baldianum (native to Argentina), G. multiflorum (native to Brazil and Argentina) and G. saglione (native to Argentina). Thirty-five other species of Gymnocalycium were reported among the imports from 1980 through 1984.

Exports/Reexports

Reported exports were far fewer than imports of this genus from 1980 through

1984. Of the 8,750 plants exported during this period, all were reported as artificially propagated.

Maihuenia

Although reportedly rare in cultivation, species of this genus are outstanding miniatures according to succulent guides (Innes, 1977). Maihuenia plants are prostrate with globular, jointed stems. The areoles bear both spines (1-3) and short, white wool. As is characteristic of its tribe, Pereskiae, Maihuenia species bear broad leaves. These small, terete leaves are persistent. The yellow or red flowers are quite large in relation to plant size. Species of Maihuenia are indigenous to the mountains of Argentina and Chile. The generic name was derived from the common name, maihuen, given by local residents.

Imports

The 46 specimens of Maihuenia imported to the U.S. in 1982 and 1983 were reported to be field-collected specimens of M. poeppigii shipped from Chile. There were no other records of U.S. trade in this genus. Although these figures are much lower than those for other genera, they are significant because the plants in trade are field collected. Species of this genus are not commonly propagated for commercial trade. Further investigation is needed to determine if CITES trade records represent the full extent of trade in this genus.

Exports/Reexports

There were no reported exports or reexports of Maihuenia specimens from 1980 through 1984.

Melocactus

All species of Melocactus are distinctive in that they produce a cephalium of long, woolly hairs and bristles. The cephalium crowns the cactus stem and thus inspired its common name, Turk's cap cactus. Small, pinkish flowers arise from the cephalium. The small, globular to short-cylindric stems are ribbed and spiney. Species of this genus are widely distributed throughout tropical South America, Central America, and the West Indies.

Several species of Melocactus occur within a relatively limited area of Brazil. Due to the incomplete species identification it is imposssible to determine if these and other species of limited distribution are in trade.

Imports

U.S. imports of Melocactus ranged from a low of 514 in 1980 to 14,400 in 1984. Nearly all of these plants originated in Brazil. The source was not

reported for over half of these imports. Eighty percent of all imports were identified only to genus. Melocactus peruvianus was the most common species of identified imports. Several species of Melocactus occur within a limited area of Brazil. Due to extremely inadequate species identification, it is impossible to determine if these relatively rare species were among the imports.

The only reported imports of cuttings occurred in 1982, when 1,600 cuttings were imported. Seeds of unidentified species of Melocactus were reexported in great number from 1980 through 1981. Approximately 10,000 seeds, plus several envelopes containing unknown quantities, were reexported over these two years.

Exports/Reexports

Unlike other South American genera considered here, the number of exports of Melocactus nearly equalled the number of imports from 1980 through 1984. Nearly half of the exports during this period were reported in 1980. In the following years, exports were few until 1984, when they rose to almost 3,800 artificially-propagated plants.

Neoporteria

Named for Chilean entomologist Carlos Porter, all species of this genus are indigenous to Chile and southern Peru. The plants are initially globular but become short-cylindric over time. The solitary, ribbed stems have densely spined areoles and are crowned with hairs. Plants of the genus produce attractive funnel-shaped flowers. The data summary and analysis for this genus include data reported for the following synonymous genera: Islaya, Chilenia, Neochilenia, Horridocactus, Thelocephala, and Pyrrhocactus (Britton and Rose, 1937; Hunt, 1967).

Imports

Imports of Neoporteria species have increased since 1980, with a dramatic increase reported in 1984. Almost half of the 11,400 plants and cuttings imported during the five year period were imported in 1984. The source was not reported for nearly half of all imports. The reporting of the source of imports has not improved since 1980 and remains extremely incomplete. Thirteen percent of the plants imported from 1982 through 1984 were reported to be field-collected specimens from Chile. The remainder of the identified imports were reported as artificially-propagated specimens, primarily from Japan in 1980 through 1983, and then solely from Brazil in 1984. Although most of the imports from 1980 through 1983 were thoroughly identified by species, in 1984, 65 percent of imports were identified only to genus. Of the identified plants, N. tuberisulcata was the most commonly imported species.

Although numerous cuttings were reported among the 1982 imports, no cuttings

were reported in any other year. No imports of seeds were reported.

Exports/Reexports

Reported exports of Neoporteria species increased in 1984. Of the almost 7,600 plants exported from 1980 through 1984, half were exported in 1984. Neoporteria subgibbosa was the most commonly exported species. All exports were reported to be artificially propagated, with no reported exports of seeds or cuttings.

Notocactus

One of the most popular genera of cacti, Notocactus comprises 20 to 30 species native to Brazil, Uruguay, and Argentina (Innes, 1977; Hunt, 1967). The globular to short-columnar plants flower readily, even when quite young. In many species the areoles are covered with dense wool and in some species the wool is quite colorful, often yellow. The attractive yellow or red flowers and the woolly stem are particularly appealing to collectors. Notocactus species are readily propagated by seed. Included in the data analysis for this genus are data reported for the synonymous genera Brasilicactus, Eriocactus, and Wigginsia.

Imports

Imports of Notocactus species increased from 1980 through 1984; nearly half were shipped from Brazil in 1984. Prior to 1984, most originated in Japan. Half of all imports were reported as artificially-propagated plants from Japan and Brazil. The source was not reported for the other half of the imports. Most of these plants originated in Brazil and may have been field collected. For the most part, imported plants were fully identified from 1980 through 1983. In 1984, however, 16,000 imported plants were identified only to genus. Of the 21 species identified among the imports, N. leninghausii, N. scopa, N. magnificus, N. ottonis, and N. herteri were the most commonly imported.

Exports/Reexports

In contrast to the reported imports, exports of Notocactus species declined from 1980 through 1984. Of the total 27,500 plants exported, 35 percent were reported in 1980. All exports were reported as artificially propagated. In all years the exports were almost exclusively of whole plants.

North American Genera

Ariocarpus

The unusual and quite popular genus of Ariocarpus is endemic to the Chihuahuan Desert of southern Texas and Mexico. The genus comprises six species.

Just one, A. fissuratus, is native to the United States. Referred to as "living rock cacti," these small plants are indeed difficult to distinguish from the rocks and sand of the desert pavement. All species are extremely slow-growing and difficult to propagate. Therefore, wild populations are the primary source of plants to satisfy the demand for these cacti. Ariocarpus are among the most heavily traded of North American cacti, although most species are quite limited in distribution and three species are listed on Appendix I of CITES.

Imports

U.S. imports of Ariocarpus species totalled more than 115,000 plants from 1980 through 1984. Reported trade was heaviest in 1983, when about 29,000 plants were imported. The reported imports and reexports were almost exclusively field-collected plants from Mexico. The source was not reported for 38 percent of imports from 1980 through 1984. Since there are few commercial sources of artificially-propagated plants in Mexico, these plants were undoubtedly field collected. No imports of seeds or cuttings were reported from 1980 through 1984. (This figure does not include 50 envelopes of unknown quantities of seed.)

The species identification of imports has improved greatly since 1980, when about 90 percent of the plants were identified only to genus. All imports of this genus were thoroughly identified in 1984.

Exports/Reexports

Reported exports of Ariocarpus species were few, totalling 45 plants from 1980 through 1984. These plant were all reported as artificially propagated. 1980 export reports included 8,000 seeds recorded as artificially propagated. It is more likely that these were field collected since the species are all extremely slow-growing and difficult to propagate.

U.S. reexports of Ariocarpus species totalled more than 40,000 plants from 1980 through 1984. Reported reexports were greatest in 1980 and have declined somewhat since.

Species identification of reexports has improved greatly since 1980 when 84 percent were not reported by species. All reexports of Ariocarpus were identified in 1984.

While legal commercial trade in three Ariocarpus species was prohibited internationally as a result of their listing on Appendix I in 1983, trade in the other species increased dramatically over the past five years. It is alarming that tens of thousands of plants of just four species were collected annually from wild populations. Most of the known populations of Ariocarpus species have been depleted by commercial and hobbyist collectors (Lyons, 1978). It is unclear how

much more commercial exploitation these natural populations will endure. Such continuous, large-scale removal of wild plants must certainly be detrimental even to large populations.

Echinofossulocactus

The attractive and unique, wavy ribs of Echinofossulocactus species inspired its common name, brain cactus. Over 30 species have been described, all indigenous to Mexico. Several species are very limited in their distribution. Data reported for the synonymous genus Stenocactus are included in this genus summary.

Imports

Imports of Echinofossulocactus species recently increased. Imports averaged about 3,000 plants per year in 1981 and 1982, increased to just over 4,000 plants in 1983 and 8,129 in 1984. From 1980 through 1984, 30 percent of the imports were reported to be field collected from Mexico and 18 percent were artificially-propagated specimens from Brazil. Sources for half of the imports, approximately 10,000 plants, were not reported: half of these plants were from Mexico and were undoubtedly field collected; the remainder were from Brazil and may have been artificially propagated. Thus it appears that 60 percent of all imports from 1980 through 1984 were field-collected specimens from Mexico.

Species identification of imports was quite thorough in 1982 and 1983. Of the identified imports E. multicostatus was the most commonly traded. In 1980, 1981, and 1984, however, most of the imported plants were identified only to genus. Identification must be improved to allow more accurate assessment of the trade in rare species. This is especially important since most of the imported plants were field collected.

There were no reports of seeds among imports of this genus, although 42,000 seeds were reported among 1980 and 1981 reexports. Some of these reexported seeds were reported as artificially propagated, but sources of most were not reported. It is likely that these "artificially-propagated" seeds were field-collected since most originated in Mexico.

Exports/Reexports

A total of 509 specimens of Echinofossulocactus were reported among exports from 1980 through 1984. Most of these plants were shipped in 1982. All exports were reported as artificially-propagated plants.

Ferocactus

The shape of these cacti inspired their common name, barrel cacti. Species range from small pincushion forms to tall cylindric-shaped plants. This is one of

the most popular genera of large cacti (Innes, 1977). Species have been heavily collected for commercial use in landscaping partly because cultivated specimens are slow to attain sufficient size for use in landscaping (Borg, 1976).

The 20 to 30 species of Ferocactus occur in the southwestern U.S., from Texas to California and south to western Mexico and the Mexican Plateau. Several species are extremely limited in distribution and are seriously threatened by commercial exploitation, including F. acanthodes var. acanthodes, F. rectispinus, F. townsendianus, and F. viridescens (Wiggins, 1980; Benson, 1982).

Imports

Thirty-five percent of Ferocactus imports reported from 1980 through 1984 occurred in 1981. Imports dropped significantly in 1983 (5,300 plants) but rose in 1984 to about 13,250 plants. One-fourth of all imports were reported as artificially-propagated plants, primarily from Brazil. Fifteen percent of the imports were field-collected plants from Mexico. The sources of over half of the imports (33,000 plants) were not reported, but 40 percent of these plants originated in Mexico and were undoubtedly field collected. The remainder of the imports originated in Brazil and may have been artificially propagated. Thus it is probable that 40 percent of all imported Ferocactus specimens were field collected plants from Mexico and most of the remainder of the imports were artificially propagated in Brazil.

Nearly 16,000 cuttings were among the 1981 and 1982 imports, but none were reported thereafter.

Approximately 80 percent of the plants imported from 1980 through 1983 were thoroughly identified, but in 1984, over half of the imports were identified only to the genus. Many of these were field-collected plants from Mexico. The reason for this negligence is not known. Of the identified species, the most commonly imported were F. latispinus, F. pilosus, and F. setispinus. Species identification must be more thorough in order to determine the extent of trade in rare species.

Exports/Reexports

Exports of Ferocactus species varied considerably from year to year. Reported exports for 1980, 1982, and 1984 ranged from 7,300 to 8,500 plants. In 1981 and 1983, reported exports did not exceed 2,135 plants. Nearly all of these exports were reported as artificially-propagated plants.

Mammillaria

This genus is one of the largest and most popular of the family. Species of Mammillaria occur in the southwestern U.S. south to Mexico and Central America with others in the Carribbean and Venezuela. Their great variability in form and

attractive flowers are appealing to collectors. The species are often colorful and intricately patterned, adding to the allure of the genus. Nearly all of the many species of Mammillaria are in demand by U.S., Japanese, and European collectors. Although many species are reported to succeed in cultivation (Chidamin, 1958), most species are propagated by seed and are slow-growing. Wild populations are exploited to fill the commercial demand for large specimens. Several species are very limited in distribution and this commercial exploitation threatens their survival.

Imports

Reported imports of Mammillaria species from 1980 through 1984 peaked at about 82,200 plants in 1981. Imports declined to 19,209 plants the following year but increased twofold in both 1983 and 1984. In 1981 and 1982 reported imports included 9,700 cuttings but no imports of cuttings were reported in the next two years. No reports of imported seed were made in the five year period.

Approximately 45 percent of the imports were reported as artificially-propagated plants, primarily from Japan and Brazil. Ten percent of the imports were reported as field-collected plants shipped from Mexico. The sources of the remainder of the imports were not reported; however, nearly half of these plants originated in Mexico and were undoubtedly field collected. Thus, the data indicate that 30 percent of the imports of Mammillaria species from 1980 through 1984 were field-collected plants from Mexico and the remainder of the imports were artificially-propagated plants, primarily from Japan and Brazil.

The species identification of reported imports has become more thorough since 1980, when all but a few of the imports were identified only to the genus. Approximately ten percent of the imported plants were identified only to the genus from 1981 through 1984. Thousands of plants continue to be imported annually without species identification. Improvement is needed, especially with the recent listing of three Mammillaria species on Appendix I. Full identification is required to enforce the Appendix I controls on trade as well as to monitor trade in at least 20 rare species of this genus that are known in trade.

Reported imports from Mexico of some rare species, such as M. lenta and M. parkinsonii, increased from 1980 through 1984 while trade in others, such as M. albicoma and M. coahuilensis declined (Table 4). Of the 105 identified species, M. spinosissima, M. karwinskiana, M. elongata, and M. marksiana were among the most commonly imported during the five year period.

Exports/Reexports

Reported reexports of Mammillaria species totalled 6,246 plants from 1980 through 1984, but exports averaged about 10,000 plants per year. The exports were reported almost exclusively as artificially-propagated plants, with few cuttings or

seeds reported. Reexports of seeds, however, totalled 50,000 (plus several envelopes of unknown quantities) in 1980 and 1981. Few seeds were reported among reexports of the following years. The source of the reexported seeds was either not reported or was reported as artificially propagated. Since the seeds originated in Mexico, they were undoubtedly field collected. This same confusion concerning the source occurred with Ariocarpus and other genera native to Mexico. The definition of artificial propagation as it relates to seeds and plant parts must be clarified for port inspectors.

Neolloydia

These small, spiny cacti have spiraling ribs. All species produce large, funnel-shaped pink or purple flowers. Collecting guides make note of the genus for its particularly attractive flowers (Innes, 1977). Britton and Rose dedicated the genus to Professor Francis Lloyd who contributed information to their work. Twelve to fifteen species of Neolloydia occur from California to Texas south to northeast Sonora and San Luis Potosi, Mexico. Two particularly rare species were listed on Appendix I in 1983. The data analysis for this genus includes data reported for the synonymous genus Echinomastus.

Imports

Imports of Neolloydia species varied in quantity from 1980 through 1984. No imports of this genus were reported in 1980, although about 1,500 plants were imported from Mexico in 1981. Imports declined until 1983, when nearly 2,000 plants were imported from Japan. Imports decreased again in 1984. Approximately half of the imports from 1980 through 1984 were reported as artificially-propagated plants shipped from Japan. The remainder of the imported plants came from Mexico and were probably field-collected specimens.

The species identification of imports was much more thorough from 1982 through 1984 than it was in 1981. Most plants imported after 1981 were fully identified. This identification enabled biologists to track the international trade in five species that are thought to be rare (three taxa occurring in trade are included in Table 4). Neolloydia beguinii and N. johnsonii were the most commonly imported of the ten species reported in trade from 1980 through 1984.

Exports/Reexports

Approximately 400 specimens of Nelloydia species were reported among reexports from 1982 through 1984. No reexports were reported prior to 1982 and most of the plants were reexported in 1983 and 1984. These plants were all field-collected specimens originally from Mexico.

All reported trade in Neolloydia was in whole plants with the exception of 90 seeds exported in 1984. Other exports from 1980 through 1984 totalled just 234

plants, all reported as artificially-propagated specimens.

Pediocactus and Sclerocactus

Trade in the species of these genera is discussed jointly because the genera are similar in appearance and similar in the limited extent of their distribution and cultivation success. The genus Sclerocactus was merged with Pediocactus (Arp, 1972), but in his recent treatise, Benson (1982) proposed that the genera should remain separated pending further study.

Their small size and extreme rarity add to their allure. Species of both genera produce attractive white or yellow to reddish flowers and their fruits are quite colorful, turning red or yellow with maturity. All species of these genera are in demand by collectors. Although nurseries in the southwestern U.S. have had success with some species, they are extremely difficult to cultivate and many plants do not survive in the care of amateur cactus enthusiasts (Glass and Foster, 1976). All species of these genera occur within limited regions of the southwestern United States. Eight species of Pediocactus and four species of Sclerocactus were listed on Appendix I in 1983. Half of these species are listed as Endangered or Threatened under the U.S. Endangered Species Act (ESA); the other half are candidates under review for listing under the ESA.

Imports

There were no reported imports of Pediocactus or Sclerocactus specimens from 1980 through 1984.

Exports/Reexports

Most of the reported U.S. trade in both Pediocactus and Sclerocactus species was in artificially propagated seeds exported from 1982 through 1984. Approximately 800 seeds of Sclerocactus species and 400 seeds of Pediocactus species were exported during this period. Of the 133 plants of Pediocactus species exported from 1980 through 1984, about one half were shipped in 1981; since then exports have declined. Just 25 plants of Sclerocactus species were exported from 1980 through 1982; none were reported in trade in the following years.

Legal international trade in both genera has been limited since 1979 by restrictions placed on those species listed under the ESA. Although the ESA also regulates interstate trade in listed species, these restrictions are difficult to enforce due to the great freedom of movement between states. Biologists employed or contracted by the U.S. government have documented the removal of plants from wild populations by cactus collectors. Commercial activity within the U.S. may be the greatest current threat to species of both genera.

All exported seeds and plants were reported as artificially propagated. It

is likely that the few seeds and plants exported from 1982 through 1984 were, in fact, artificially propagated since they were shipped by the few nurseries licensed to export propagated specimens by the Federal Wildlife Permit Office.

The species identification for both genera was extremely thorough in all years from 1980 through 1984. Sclerocactus mesae-verdae, S. glaucus, and Pediocactus bradyi were the most commonly exported species of these genera.

There were no reported imports or reexports of specimens of either genus.

Pelecyphora

This genus is composed of just two species, both listed on Appendix I in 1981: Pelecyphora aselliformis and P. strobiliformis. The small globular plants of these species may be solitary or clustering and the plants are not ribbed but have flattened tubercles. The generic name, derived from the Greek word meaning hatchet, refers to the shape of the tubercles.

Both species occur within a very limited region of Mexico. Although these plants are popular among collectors, cultivation is reported to be quite difficult with high mortality rates for both species. Therefore, wild populations were the primary source of plants in commercial trade. Concern for the survival of these species under extensive commercial exploitation led to their listing under Appendix I.

Imports

In 1980 and 1981, prior to their Appendix I listing, reported imports of Pelecyphora species totalled about 17,000 plants. These imports were all from Mexico and were undoubtedly field-collected plants (although the source was not reported for over half of the plants).

Exports/Reexports

In 1980 and 1981 reexports totalled 6,164 plants and all originated in Mexico (Table 4). Nearly 1,400 of the reexported plants were reported as artificially propagated; however, these too were most likely field collected since there is little commercial propagation in Mexico. A total of 33 artificially-propagated plants were reported as exports in 1980 and 1981.

The listing of these species on Appendix I prohibited legal commercial trade in field-collected specimens. From 1982 through 1984 just 17 plants of this genus were reported in trade, all artificially-propagated specimens. According to CITES data, enforcement of the Appendix I trade restrictions has been stringent but illegal trade in this genus may continue. Plants may be imported under other names or may bypass port inspection via the postal system.

Turbinicarpus

These small, solitary cacti occur in isolated groups scattered over low hillsides of the eastern Chihuahuan Desert in central Mexico. The six species of the genus are all in great demand by cactus fanciers due to their small size, attractive spination, and appealing flowers. Cactus collecting guides note this genus for its success in cultivation (Innes, 1977; Lamb and Lamb, 1975). Populations are reported to have been depleted by extensive field collection by commercial collectors and hobbyists. Seeds are field collected for propagation but most of the trade reported for this genus is in field collected plants. Due to the rarity of all Turbinicarpus species and the extensive trade in field-collected plants, the entire genus was listed on Appendix I of CITES in 1983.

Imports

Reported imports of Turbinicarpus species totalled 27,707 plants from 1980 through 1984. Roughly half of these were imported in 1981. After the genus was listed on Appendix I in 1983, imports increased. It is unclear why 3,900 field-collected specimens of Appendix I species were allowed entry to the U.S. in 1984. Such shipments are absolutely prohibited by the CITES regulations concerning species listed on Appendix I. Although U.S. import permits are required for imports of Appendix I species, no such permits were reported by port inspectors.

Nearly eighty percent of the imports reported from 1980 through 1984 were of field-collected plants from Mexico. The source was not reported for most of the remaining 20 percent. Reports of the source were complete in 1984, a sign of increasingly thorough reporting. Species identification was far more thorough from 1982 through 1984 than for 1980 and 1981. Turbinicarpus pseudopectinatus, T. schmiedickeanus, and T. valdezianus were the most commonly imported of the identified species. All imports were of whole plants.

Exports/Reexports

Reported reexports also were greatest in 1981, when approximately 2,500 plants were reexported. The following year reexports declined slightly. In 1983 and 1984 the number of reexports was approximately one-fourth the 1981 total. All reexports were of whole plants. Of the total 6,301 reexports reported from 1980 through 1984, about 44 percent were reported as field-collected plants and 17 percent were reported as artificially-propagated plants. Nearly all of the reported artificially-propagated specimens originated in Mexico and were undoubtedly field collected. The source was not reported for nearly 40 percent of the reexports but nearly all of these plants originated in Mexico and must have been field collected. Therefore, it is probable that most of the reexports were of field-collected plants.

Exports of Turbinicarpus species were very few, totalling 224 plants from 1980 through 1984. Just four plants were exported in 1984. All exports were reported as artificially-propagated plants.

More stringent enforcement of Appendix I trade restrictions is essential. Continued international commercial trade in wild specimens of Turbinicarpus species is illegal and seriously threatens the survival of wild populations. Artificial propagation must be encouraged in order to reduce illegal collection pressure on wild populations.

Summary

Total reported U.S trade in succulents of the six families, excluding cacti, increased from approximately 235,000 plants and cuttings in 1980 to about 523,000 in 1984. This increase in trade was consistent over four of the five years, with a five percent decline in trade in 1982. The sharpest increase was a 65 percent jump from 1983 (317,000) to 1984, reflecting increased imports of aloes and euphorbs (Table 1). Imports of Anacampseros species, Ceropegia species, species of Didiereaceae, and Pachypodium species declined during the five year period. Exports were fewer than imports for most of the listed taxa. During this period increased exports were reported for Pachypodium species, Ceropegia species, and Euphorbia species. Exports of Anacampseros species changed very little while reported exports of Aloe species decreased sharply. There were few reported reexports of these succulents.

Imports, exports and reexports of cacti followed a similar pattern from 1980 through 1984, declining sharply in 1981 or 1982 and then increasing in 1984 to exceed all prior years. Exports averaged about 60,000 plants annually but climbed to over 100,000 plants in 1984. Cactus imports averaged 1.37 million plants annually with a high of 1.6 million cacti imported in 1984. Most of the cactus reexports were of Mexican seeds shipped in 1980 and 1981. The decline from nearly 300,000 seeds reexported in 1980 to none in 1984 may reflect a lack of reporting due to the consideration of seeds as plant parts. Reexports of whole plants declined from about 33,700 in 1980 to about 10,600 in 1984 (Table 2). This decline may reflect reduced imports from Mexico during the same period or better enforcement of reexport permit requirements.

From 1980 through 1984, species identification of imported and exported succulents increased while identification of reexports remained consistently incomplete. By 1984, the identification of most exported succulents was quite thorough, with the exception of Anacampseros species. The identification of imported succulents remains extremely inadequate. For example, 35 percent of the imported cacti were identified only to family. It is impossible to monitor trade in rare plants when hundreds of thousands of traded plants are identified only to the family or genus. In order to achieve the purposes of CITES and fulfill the reporting requirements it is essential that species identification be complete

for all traded plants. Port inspectors must refuse entry to plant shipments until complete identification is provided by the shipper.

The identification of the sources of succulents in trade increased for many taxa in 1981 or 1982 but then declined. Nearly all exported succulents were reported as artificially propagated. Identification of the sources of imported and reexported succulents was extremely inadequate and in some cases the accuracy of reported sources is questionable. Further effort is needed in reporting sources and in checking the accuracy of the sources indicated on CITES permits for plant shipments. Field-collected plants may by shipped illegally under certificates for artificially propagated plants. Plant sources must be fully and correctly identified so that biologists and government representatives may determine the impact of commercial trade on wild populations.

While international trade in succulents increased, CITES trade reports became more thorough. This improvement may be due to increased efforts of government staff responsible for administering CITES as well as to greater cooperation from CITES permittees. While the improvement is significant, far greater efforts are needed to fully comply with CITES reporting requirements. With these efforts, the extent and effects of trade in rare species may be assessed accurately and species listings may be modified to reflect that knowledge.

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Table 1
Succulent Genera other than Cacti in U.S. Trade
1980-1984

Family	Genus[1]	E/I/R[2]	Year	Source[3]	Quantity
Apocynaceae	(unknown)	E	80	A	17
		E	81	A	13
		E			30
		I	84	A	1
					31
	Pachypodium	E	80	A	93
		E	81	A	152
		E	82	A	38
		E	83	A	79
		E	84	A	259
		E			621
		I	80	A	984
		I	80	U	49
		I	81	A	1,520
		I	81	U	510
		I	82	A	179
		I	82	U	139
		I	83	A	1,055
		I	83	U	4
		I	84	A	595
		I			5,035
					5,656
Apocynaceae					5,687
Asclepiadaceae	Ceropegia	E	80	A	35
		E	81	A	20
		E	82	A	31
		E	83	A	62
		E	84	A	93
		E			241
		I	80	A	1
		I	82	A	1
		I	84	A	2
		I			4

Table 1
Succulent Genera other than Cacti in U.S. Trade
1980-1984

Family	Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
		R	81	W	1
					246
Asclepiadaceae	Frerea	E	82	A	1
		E	84	A	1
		E			2
					2
Asclepiadaceae					248
Didiereaceae	Alluaudia	E	80	A	15
		E	81	A	26
		E	82	A	15
		E	83	A	15
		E	84	A	8
		E			79
		I	82	A	2
		I	82	U	4
		I	83	A	118
		I	84	A	82
		I			206
					285
	Alluaudiopsis	E	80	A	10
		E	81	A	7
		E	82	A	2
		E	84	A	1
		E			20
					20
	Decaryia	E	80	A	20
		E	81	A	7
		E	84	A	3
		E			30
					30

Table 1
Succulent Genera other than Cacti in U.S. Trade
1980-1984

Family	Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
Didiereaceae		E	81	A	6
		I	80	A	1
					7
	Didierea	E	80	A	23
		E	81	A	7
		E	82	A	1
		E	83	A	2
		E			33
		I	80	A	110
		I	81	A	1
		I	82	A	2
		I	82	U	2
		I	83	A	238
		I	84	A	67
		I			420
					453
Didiereaceae					795
Euphorbiaceae	Euphorbia	E	80	A	2,494
		E	81	A	2,519
		E	82	A	2,654
		E	83	A	5,472
		E	84	A	5,150
		E			18,289
		I	80	A	197,238
		I	80	U	9,234
		I	81	A	214,294
		I	81	U	2,593
		I	82	A	238,966
		I	82	U	12,983
		I	82	W	18
		I	83	A	229,153
		I	83	U	1,212
		I	83	W	13
		I	84	A	40,270
		I	84	U	377,776
		I	84	W	25
		I			1,323,775

Table 1
Succulent Genera other than Cacti in U.S. Trade
1980-1984

Family	Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
		R	80	U	1
		R	81	W	5
		R			6
					1,342,070
Euphorbiaceae	unknown	E	80	A	124
		E	81	A	85
		E			209
					209
Euphorbiaceae					1,342,279
Liliaceae	Aloe	E	80	A	304
		E	81	A	94,121
		E	82	A	16,302
		E	83	A	9,310
		E	84	A	4,298
		E			124,335
		I	80	A	270
		I	80	U	24,119
		I	81	A	3,268
		I	81	U	50
		I	82	A	29,512
		I	83	A	68,949
		I	83	W	6
		I	84	A	224
		I	84	U	93,682
		I			220,080
					344,415
Liliaceae	unknown	E	80	A	18
		E	81	A	11
		E			29

Table 1
Succulent Genera in Trade other than Cacti
1980-1984

Family	Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
		I	82	W	15
					44
Liliaceae					344,459
Portulacaceae	unknown	E	80	A	6
		E	81	A	13
		E			19
					19
					484
	Anacampseros	E	80	A	29
		E	81	A	74
		E	82	A	11
		E	83	A	25
		E	84	A	75
		E			214
		I	80	A	6
		I	80	U	70
		I	81	A	111
		I	81	U	10
		I	82	A	25
		I	84	A	19
		I	84	U	10
		I			251
					465
					1,693,952

[1]Family names included under the genus column reflect CITES records that identify plants only to the family.
[2]E=Export, I=Import, R=Reexport
[3]A=Artificially Propagated, W=Wild Collected, U=Not Reported
[4]Data include only individual whole plants and cuttings. Seeds are not included. Specimens reported only by weight or as shipments of unknown quantity are not included.

Table 2
U.S. Cactus Imports, Exports, and Reexports, 1980-1984 (by plant product)

Year	E/I/R[1]	Product[2]	Source[3]	Quantity
80	E		A	69,714
80	E	CUTT	A	18
80	E	SDLG	A	282
80	E	SEED	A	20,000
80	E	SLDG	A	2
	E			90,016
80	I		A	494,621
80	I		U	557,378
80	I		W	31,291
80	I	CUTT	A	79
80	I	CUTT	W	6
80	I	SDLG	A	270,000
80	I	SEED	U	1
	I			1,353,376
80	R		A	619
80	R		U	31,131
80	R		W	1,956
80	R	CUTT	U	25
80	R	SEED	U	277,037
80	R	SEED	W	6,000
	R			316,768
80				1,760,160
81	E	CUTT	A	4,562
81	E	LIVE	A	31,977
81	E	LIVE	W	6
81	E	SDLG	A	535
	E			37,080
81	I	CUTT	A	17
81	I	CUTT	U	15,705
81	I	LIVE	A	1,283,749
81	I	LIVE	U	77,657
81	I	LIVE	W	127,073
81	I	SDLG	A	2,761
81	I	SDLG	W	2
	I			1,506,964

Table 2
U.S. Cactus Imports, Exports, and Reexports, 1980-1984 (by plant product)

Year	E/I/R[1]	Product[2]	Source[3]	Quantity[4]
81	R	LIVE	A	11,002
81	R	LIVE	W	17,531
81	R	SEED	A	114,500
	R			143,033
81				1,687,077
82	E	CUTT	A	2,284
82	E	LIVE	A	45,555
82	E	LIVE	U	16
82	E	SDLG	A	4
82	E	SEED	A	426
	E			48,285
82	I	CUTT	A	26,109
82	I	CUTT	U	384,998
82	I	CUTT	W	76
82	I	LIVE	A	417,496
82	I	LIVE	U	156,108
82	I	LIVE	W	42,694
82	I	SCSP	U	4
82	I	SDLG	A	9,042
	I			1,036,527
82	R	LIVE	A	1,072
82	R	LIVE	U	14,528
82	R	LIVE	W	535
82	R	SEED	U	22,006
	R			38,141
82				1,122,953
83	E	CUTT	A	2,635
83	E	LIVE	A	39,746
83	E	SDLG	A	201
83	E	SEED	A	8,290
	E			50,872
83	I	CUTT	U	99
83	I	LIVE	A	484,943
83	I	LIVE	U	784,629
83	I	LIVE	W	54,470

Table 2
U.S. Cactus Imports, Exports, and Reexports, 1980-1984 (by plant product)

Year	E/I/R[1]	Product[2]	Source[3]	Quantity[4]
83	I	SDLG	A	990
83	I	SDLG	U	49,650
83	I	SEED	W	52
	I			1,374,833
83	R	CUTT	W	5
83	R	LIVE	W	18,600
83	R	SEED	W	10
	R			18,615
83				1,444,320
84	E	CUTT	A	8,864
84	E	LIVE	A	108,267
84	E	SDLG	A	58
84	E	SEED	A	900
84	E	WOOD	A	708
	E			118,797
84	I	CUTT	A	211
84	I	CUTT	W	125
84	I	LIVE	A	726,347
84	I	LIVE	U	826,284
84	I	LIVE	W	48,496
84	I	SCSP	U	2
84	I	SDLG	A	210
	I			1,601,675
84	R	LIVE	U	257
84	R	LIVE	W	10,386
	R			10,643
84				1,731,115
				7,745,625

[1]E=Export, I=Import, R=Reexport
[2]Products: CUTT=Cuttings, LIVE=Live Plant, SDLG=Seedling, SCSP=Scientific Specimen, SEED=Seeds, WOOD=Wood or Wood Products.

[3]Source: A=Artificially Propagated, W=wild, field collected, U=Not Reported

[4]Data include only CITES records of individuals; records reporting only the weight of specimens or reporting shipments of unknown numbers of plants are not included.

Table 3

Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	North American Genera			
Ariocarpus	E	80	A	30
	E	81	A	5
	E	82	A	3
	E	83	A	1
	E	84	A	6
	E			45
	I	80	U	21,611
	I	80	W	1,050
	I	81	W	23,725
	I	82	A	3
	I	82	U	2,895
	I	82	W	13,384
	I	83	A	32
	I	83	U	11,627
	I	83	W	17,620
	I	84	A	4
	I	84	U	8,156
	I	84	W	15,823
	I			115,930
	R	80	A	251
	R	80	U	10,388
	R	80	W	392
	R	81	A	3,759
	R	81	W	4,474
	R	82	A	19
	R	82	U	6,027
	R	82	W	215
	R	83	W	9,646
	R	84	W	5,503
	R			40,674
Ariocarpus	TOTAL			156,649
Echinofossulocact.	E	80	A	2
	E	81	A	51
	E	82	A	416
	E	83	A	31
	E	84	A	9

Table 3
Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	E			509
	I	80	U	1,800
	I	81	A	875
	I	81	W	2,340
Echinofossulocact.	I	82	U	2,000
	I	82	A	4
	I	82	W	900
	I	83	A	7
	I	83	U	3,623
	I	83	W	850
	I	84	A	2,128
	I	84	U	2,751
	I	84	W	3,250
	I			20,528
	R	80	U	150
	R	81	A	276
	R	82	U	40
	R	83	W	467
	R	84	W	18
	R			951
Echinofossulocact.	TOTAL			21,988
Ferocactus		0		0
	E	80	A	7,592
	E	81	A	1,769
	E	81	W	1
	E	82	A	7,292
	E	83	A	2,135
	E	84	A	8,453
	E			27,242
	I	80	U	2,250
	I	81	A	8,604
	I	81	U	6,157
	I	81	W	6,744
	I	82	A	400
	I	82	U	17,370
	I	82	W	550

Table 3

Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	I	83	A	2
	I	83	U	4,387
	I	83	W	914
	I	84	A	6,100
	I	84	U	6,375
	I	84	W	771
	I			60,624
	R	80	U	490
	R	80	W	133
	R	81	A	307
	R	81	W	266
	R	82	A	2
	R	82	U	76
	R	82	W	12
	R	83	W	623
	R	84	W	185
	R			2,094
Ferocactus	TOTAL			89,960
Mammillaria	E	80	A	13,124
	E	81	A	5,656
	E	81	W	3
	E	82	A	10,620
	E	83	A	12,675
	E	84	A	10,116
	E			52,194
	I	80	A	6
	I	80	U	15,980
	I	80	W	1,000
	I	81	A	69,515
	I	81	U	2,095
	I	81	W	10,612
	I	82	A	4,884
	I	82	U	12,668
	I	82	W	1,657
	I	83	A	2,452
	I	83	U	26,974
	I	83	W	4,818
	I	84	A	18,262
	I	84	U	44,512
	I	84	W	1,078
	I			216,513

Table 3

Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	R	80	U	4,183
	R	80	W	113
	R	81	A	730
	R	81	W	200
	R	82	U	514
	R	83	W	190
	R	84	W	316
	R			6,246
Mammillaria	TOTAL			274,953
Neolloydia				
	E	80	A	105
	E	81	A	40
	E	82	A	20
	E	83	A	14
	E	84	A	55
	E			234
	I	81	W	1,507
	I	82	A	500
	I	82	U	337
	I	83	A	2
	I	83	U	1,900
	I	83	W	250
	I	84	W	825
	I			5,321
	R	82	U	5
	R	83	W	287
	R	84	W	161
	R			453
Neolloydia	TOTAL			6,008
Pediocactus	E	80	A	19
	E	81	A	69
	E	82	A	23
	E	83	A	17
	E	84	A	5
	E			133
Pediocactus	TOTAL			133

Table 3
Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
Pelecyphora	E	80	A	31
	E	81	A	2
	E			33
	I	80	U	12,300
	I	81	W	4,700
	I	83	A	17
	I			17,017
	R	80	U	4,330
	R	80	W	222
	R	81	A	1,367
	R	81	W	245
	R			6,164
Pelecyphora	TOTAL			23,214
Sclerocactus	E	80	A	5
	E	81	A	6
	E	82	A	14
	E			25
Sclerocactus	TOTAL			25
Turbinicarpus	E	80	A	31
	E	81	A	63
	E	82	A	58
	E	83	A	68
	E	84	A	4
	E			224
	I	80	U	3,350
	I	81	A	2
	I	81	W	14,202
	I	82	U	2,000
	I	82	W	3,800
	I	83	A	1
	I	83	U	350
	I	83	W	100
	I	84	A	2
	I	84	W	3,900
	I			27,707

Table 3
Summary of Selected North and South American Cacti Found in Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	R	80	A	100
	R	80	U	652
	R	80	W	5
	R	81	A	799
	R	81	W	1,658
	R	82	A	187
	R	82	U	1,815
	R	83	W	490
	R	84	W	595
	R			6,301
Turbinicarpus	TOTAL			34,232
GRAND TOTAL (North American)				607,162
	South American Genera			
Borzicactus	E	80	A	1,535
	E	81	A	850
	E	82	A	313
	E	83	A	1,001
	E	84	A	8,102
	E			11,801
	I	80	A	4
	I	80	U	1,000
	I	81	A	5,126
	I	82	A	216
	I	82	U	970
	I	82	W	17
	I	83	A	43
	I	83	U	500
	I	84	A	506
	I	84	U	2,005
	I	84	W	46
	I			10,433
Borzicactus	TOTAL			22,234
Copiapoa	E	80	A	127
	E	81	A	69
	E	82	A	26
	E	83	A	378

Table 3
Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	E	84	A	53
				653
	I	81	A	10
	I	81	U	680
	I	82	A	475
	I	82	U	960
	I	82	W	300
	I	83	A	637
	I	83	U	2,755
	I	83	W	370
	I	84	A	11,280
	I	84	U	2,361
	I	84	W	15
	I			19,843
	R	83	W	10
Copiapoa	TOTAL			20,506
Discocactus	E	80	A	40
	E	81	A	30
	E	82	A	47
	E	83	A	20
	E	84	A	18
	E			155
	I	80	A	253
	I	81	A	3
	I	83	A	10
	I	83	U	7
	I	84	A	6
	I			279
Discocactus	TOTAL			434
Gymnocalycium	E	80	A	909
	E	81	A	1,697
	E	82	A	4,147
	E	83	A	344
	E	84	A	1,653

Table 3
Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	E			8,750
	I	80	A	100,010
	I	80	U	74,133
	I	81	A	332,785
	I	81	U	2,190
	I	82	A	122,211
	I	82	U	18,172
	I	82	W	14
	I	83	A	56,121
	I	83	U	304,975
	I	83	W	161
	I	84	A	333,975
	I	84	U	92,421
	I			1,437,168
	R	83	W	20
	R	84	U	13
	R			33
Gymnocalycium	TOTAL			1,445,951
Maihuenia	I	82	W	6
	I	83	W	36
	I			42
Maihuenia	TOTAL			42
Melocactus	E	80	A	9,027
	E	81	A	5,760
	E	82	A	3,218
	E	83	A	1,121
	E	84	A	3,781
				22,907
	I	80	A	4
	I	80	U	510
	I	81	A	4
	I	81	W	353
	I	82	A	1,681
	I	82	U	1,630
	I	83	A	413
	I	83	U	125

Table 3
Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	I	84	A	6,501
	I	84	U	7,943
	I			19,164
	R	80	U	3
	R	81	A	52
	R	83	W	3
	R			58
Melocactus	TOTAL			42,129
Neoporteria	E	80	A	1,620
	E	81	A	157
	E	82	A	153
	E	83	A	1,554
	E	84	A	4,118
				7,602
	I	80	U	1,000
	I	81	A	2,254
	I	82	A	177
	I	82	U	1,002
	I	82	W	379
	I	83	A	19
	I	83	U	100
	I	83	W	639
	I	84	A	2,612
	I	84	U	3,033
	I	84	W	196
	I			11,411
Neoporteria	TOTAL			19,013
Notocactus	E	80	A	10,247
	E	81	A	3,741
	E	82	A	5,281
	E	83	A	4,852
	E	84	A	3,354
				27,475
	I	80	A	4
	I	80	U	2,000
	I	81	A	27,270

Table 3
Summary of Selected North and South American Cacti Found in U.S. Trade, 1980-1984

Genus[1]	E/I/R[2]	Year	Source[3]	Quantity[4]
	I	81	U	4,610
	I	82	A	9,460
	I	82	U	11,436
	I	83	A	323
	I	83	U	12,565
	I	83	W	10
	I	84	A	26,399
	I	84	U	36,417
	I			130,494
Notocactus	TOTAL			157,969
TOTAL (South American)				1,628,935

[1]Family names included under the genus column reflect CITES records that identify plants only to the family.
[2]E=Export, I=Import, R=Reexport
[3]Source: A=Artificially Propagated, W=Wild, Field Collected, U=Unreported
[4]Data include only individual whole plants and cuttings. Seeds are not included. Specimens reported only by weight or as shipments of unknown quantity are not included.

Table 4

U.S. Imports and Reexports of Plants and Cuttings of Rare Cacti from Mexico

Genus	Species[1]	STATUS*	Quantity per year 1980	1981	1982	1983	1984	Total
Ariocarpus	agavoides	1E	6,000	1,212	0	0	0	7,212
Ariocarpus	kotschoubeyanus	V	1,072	3,154	1,865	2,419	3,270	11,780
Ariocarpus	kotschoubeyanus ll.	V	0	0	2	0	0	2
Ariocarpus	kotschoubeyanus mc.	V	0	0	5	0	0	5
Ariocarpus	retusus	V	820	3,894	8,437	23,186	16,424	52,761
Ariocarpus	scapharostrus	1E	0	110	0	0	0	110
Ariocarpus	trigonus	1V	0	212	2,159	2,757	2	5,130
Ariocarpus	trigonus elong.	1V	0	0	500	0	0	500
Astrophytum	capricorne	V	11	853	1,760	1,143	3,193	6,960
Astrophytum	capricorne niveum	V	0	2	22	450	0	474
Astrophytum	capricorne senilis	V	0	11	0	0	0	11
Astrophytum	myriostigma	V	531	2,891	1,610	6,996	6,419	18,447
Astrophytum	myriostigma specim.	V	0	1	0	0	0	1
Astrophytum	ornatum	V	0	0	1	4	0	5
Aztekium	ritteri	1E	2,897	1,836	0	0	0	4,733
Aztekium	ritteri clr.	1E	2	0	0	0	0	2
Backebergia	militaris	1I	45	6	32	51	3	137
Cephalocereus	senilis	V	25	804	0	261	1,204	2,294
Coryphantha	poselgeriana	V	0	8	271	790	288	1,357
Coryphantha	reduncuspina	K	0	0	7	0	0	7
Echinocactus	grusonii	E	0	2	35	0	72	109
Echinocereus	delaetii	V	0	1,523	10	280	925	2,738
Echinocereus	knippelianus	V	0	221	0	40	0	261
Echinocereus	reichenbachii fitc.	P	0	1	0	0	0	1

Table 4

U.S. Imports and Reexports of Plants and Cuttings of Rare Cacti from Mexico

Genus	Species[1]	STATUS*	Quantity per year 1980	1981	1982	1983	1984	Total
Epithelantha	micromeris greggii	I	10	0	310	0	0	320
Epithelantha	micromeris polycep.	E	0	0	15	0	0	15
Ferocactus	acanthodes acantho.	P	0	136	74	0	0	210
Ferocactus	chrysacanthus	E	0	61	3	0	0	64
Ferocactus	mathssonii	PE	209	0	0	0	0	209
Ferocactus	rectispinus	P	0	0	0	0	1	1
Ferocactus	reppenhaggi	V	0	0	0	200	0	200
Leuchtenbergia	principis	IV	124	202	490	85	0	901
Mammillaria	albicoma	V	1,000	0	0	1	0	1,001
Mammillaria	coahuilensis	PV	0	0	1,135	62	0	1,197
Mammillaria	colombiana	K	0	6	0	0	0	6
Mammillaria	elegans supertexta	V	0	0	1	0	0	1
Mammillaria	herrerae	V	0	4	0	0	0	4
Mammillaria	huitzilopochtli	V	0	3	0	0	0	3
Mammillaria	humboldtii	V	0	94	105	97	5	301
Mammillaria	humboldtii guerra	V	4	0	0	0	0	4
Mammillaria	johnstonii	R	0	0	0	100	0	100
Mammillaria	klissingiana	V	0	440	0	0	0	440
Mammillaria	lenta	PV	0	225	783	160	981	2,149
Mammillaria	magnifica	R	0	1	0	0	0	1
Mammillaria	moellerana	R	0	1	0	0	0	1
Mammillaria	parkinsonii	R	835	504	317	1,436	275	3,367
Mammillaria	pilispina	R	0	3	0	0	0	3
Mammillaria	schiedeana	V	0	1	0	0	0	1
Mammillaria	solisioides	IV	0	8	0	0	0	8
Mammillaria	theresae	V	0	3	0	0	0	3

Table 4

U.S. Imports and Reexports of Plants and Cuttings of Rare Cacti from Mexico

Genus	Species[1]	STATUS*	Quantity per year 1980	1981	1982	1983	1984	Total
Mammillaria	zephyranthoides	R	0	4	0	0	0	4
Marenopuntia	marenae	E	0	1	84	3	0	88
Melocactus	dawsonii	V	0	3	0	0	0	3
Melocactus	oaxacensis	V	0	0	0	125	0	125
Neolloydia	beguinii	V	0	0	155	537	0	692
Neolloydia	unguispina	R	0	4	40	0	0	44
Neolloydia	unguispina laui	R	0	3	0	0	0	3
Obregonia	denegrii	1E	4,152	1,201	0	0	0	5,353
Ortegocactus	macdougallii	V	0	0	952	0	0	952
Pelecyphora	aselliformis	1V	0	557	0	0	0	557
Pelecyphora	aselliformis clr.	1V	5	0	0	0	0	5
Pelecyphora	sp.	1	11,200	3,780	0	17	0	14,997
Pelecyphora	strobiliformis	1E	2,560	1,822	0	0	0	4,382
Strombocactus	disciformis	1V	0	772	2,603	170	6	3,551
Thelocactus	macdowellii	R	0	0	0	460	0	460
Turbinicarpus	'dickisonia'	1	0	0	52	0	0	52
Turbinicarpus	'gracilis'	1	0	0	3	0	0	3
Turbinicarpus	'krainzianus'	1	0	1,000	0	0	0	1,000
Turbinicarpus	'sclinkeri'	1	0	2	0	0	0	2
Turbinicarpus	laui	1E	0	0	235	0	0	235
Turbinicarpus	lophophoroides	1E	0	2	16	0	0	18
Turbinicarpus	pseudomacrochele	1	0	48	218	120	0	386

Table 4

U.S. Imports and Reexports of Plants and Cuttings of Rare Cacti from Mexico

Genus	Species[1]	STATUS*	Quantity per year 1980	1981	1982	1983	1984	Total
Turbinicarpus	pseudopectinatus	1E	15	93	5,983	359	3,376	9,826
Turbinicarpus	schmiedickeanus	1E	0	2	88	76	0	166
Turbinicarpus	schmiedickeanus ma.	1E	0	1,042	0	0	0	1,042
Turbinicarpus	schmiedickeanus sc.	1E	0	0	0	50	0	50
Turbinicarpus	sp.	1	4,092	14,435	6	0	0	18,533
Turbinicarpus	valdezianus	1E	0	35	1,201	335	1,119	2,690
Wilcoxia	schmollii	1V	0	3	22	0	0	25
			35,607	43,242	31,607	42,770	42,770	190,791

[1]Data for synonyms reported in CITES Annual Reports have been included under these preferred names.

*Status: 1=CITES Appendix I species as of August 1983, P=Species proposed for listing on Appendix I in 1983. IUCN Categories: E=Endangered, I=Indeterminate, V=Vulnerable, K=Insufficiently Known, R=Rare (defined in Lucas and Synge, 1978).

The U.S. Cactus Business, 1984

Douglas Fuller

Introduction

In November 1984, TRAFFIC(U.S.A.) elected to send a staff biologist to the southwest United States to examine the trade in wild-collected and propagated plants. This effort represented one of the first extensive field investigations that TRAFFIC(U.S.A.) has undertaken since its inception in 1979, although TRAFFIC(U.S.A.) has been deeply involved with cactus and succulent conservation since 1981. This chapter presents a brief summary of my survey of cactus and other succulent nurseries carried out during 1984. Although my work touched upon trade in other succulent families, my main focus was on trade in the Cactaceae, a family with its greatest species diversity in the New World. I have not included any discussion of trade in other succulent families. A more comprehensive study is needed to determine the effects of U.S. trade on non-cactaceous succulent families.

As principal investigator, I concentrated on cactus and succulent nurseries in Texas, New Mexico, Arizona, and California. These southwestern states have a climate favorable for growing cacti and succulents. The warm, dry conditions in the states of Texas, New Mexico, Arizona, and California allow cactus growers to maintain nurseries inexpensively; consequently the region has the highest concentration of growers and collectors in the United States. Portions of these states lie within the northern Chihuahuan, Sonoran, and Mojave desert zones, which support a fantastic array of xerophytic plant species often exploited by collectors and nurserymen (Benson, 1982; Oldfield, 1984; Steenbergh and Lowe, 1977).

Collection is one of the most serious threats to wild xerophytes. Lyman Benson (1982), the well-known cactus taxonomist, cites commercial exploitation as one of the principal threats to the North American Cactaceae.

Methodology

My methods for studying the southwest nursery business varied somewhat during the trip. At each nursery, I attempted to interview nurserymen and inspect their cactus and succulent stock. I approached the cactus nurserymen in Texas as a buyer and cactophile because my studies of nursery plant catalogues led me to suspect that the nurseries in southern Texas sold a high percentage of wild-collected plants and I believed that this would be the best way to get the most information from them. At other locations I presented myself as a researcher from the World Wildlife Fund-U.S. Throughout my trip I also made a special effort to gather data on trade in wild-collected CITES

Appendix I Mexican cactus species because they are readily recognizable and subject to strict trade controls.

In each nursery visited, I sampled the number of wild-plants and artificially-propagated cacti for sale. To determine if a plant is of wild or artificially-propagated origin is largely a matter of guesswork. General appearance can provide excellent clues: wild cacti often exhibit such irregular features as sunburned epidermis, insect holes or damage, or asymmetry. The relative size of a nursery plant may serve as another indication of its origin. For example, if cactus plants offered for sale are large specimens (relative to their species) and belong to a species that grows slowly then they probably originated from the wild. On the other hand, many cacti originate from seed in nurseries and do not take many years to reach 3-5 inch diameter marketable size. In most cases, overall appearance and growth rates enable observers to determine the origin of a given specimen.

Mexico's Influence on the U.S. Cactus Trade

Historically, U.S. cactus traders have depended upon Latin American countries for major supplies of cacti and succulents (Pizzetti, 1985). Mexico, in particular, has been a principal source of ornamental xerophytes. Mexico's proximity to the U.S. and its high species diversity contribute to the high conservation priority given its desert flora by plant conservationists. Conservationists are most concerned by the possible adverse effects of cactus collection on native species — especially of slow-growing taxa that the International Union for Conservation of Nature and Natural Resources (IUCN) considers "Endangered," "Vulnerable," or "Rare" (Fuller, 1985; Oldfield, 1984, 1985).

The U.S. Department of Agriculture has consistently allowed imports of large numbers of these Mexican endemics, although in recent years imports have declined sharply (Campbell, 1984). This decrease can be attributed to a variety of factors, including U.S. implementation of The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) trade controls and an overwhelming increase in the production of artificially-propagated plants in the United States.

Unfortunately, Mexico has not joined CITES and apparently does little to control the export of wild plants. However, some sketchy legal measures do exist to protect Mexico's native plants. For example, a Mexican Presidential Decree issued in in 1940 banned export of orchids and cacti. But, the validity of this decree is currently in question, and Mexican authorities have not determined the proper permit-issuing authorities for plant trade now

considered legal (Jorgenson, pers. comm.).

In the following summary of my survey, I describe my findings on a regional basis, because this seems to best reflect the subtle regional differences in species composition and intensities of cultivation that I observed.

Southern and Western Texas

Desertification is progressing faster in Texas than in any other state (Anon., 1981). Development is pressuring the state's natural resources, which are now in short supply and appear to be dwindling fast.

Texas' native cacti are among those resources that seem to be suffering as a result of environmental degradation. Although Benson (1982) has differentiated 126 different cactus taxa (i.e. species or varieties) within Texas, indicating that Texas has extraordinary cactus habitat, seven of native cactus taxa are listed as threatened or endangered under the U.S. Endangered Species Act (ESA).

I visited a total of ten nurseries in Texas, half of which specialized in cacti and succulents. I also visited several non-specialty nurseries that carried cacti along with ornamental shrubs, trees, and herbaceous plants. Most of these non-specialty nurseries did not offer Appendix I cacti.

In Austin, I found only one nursery that specialized in desert plants. This nursery offered a number of Appendix I species such as the agave cactus (Leuchtenbergia principis), the living-rock cacti (Ariocarpus agavoides, A. scapharostrus), the feather cactus (Mammillaria plumosa), and the artichoke cactus (Obregonia denegrii). From the appearance of this nursery's plants, I estimated that one third of the plants had originated from the wild. The owner, however, stated that he was not involved with any of the "wild stuff." I knew this was not the case when I saw a tray of mature peyote cactus (Lophophora spp.).

Along the Rio Grande River valley, between Brownsville and Laredo, there are a number of nurseries specializing in cacti and other succulents. According to United States Department of Agriculture (USDA) inspectors, importers in this region bring in many wild Mexican species of cacti, cycads, and orchids (Jones, pers. comm.).

I visited two nurseries in that area; one nursery had a very crude setup, poor maintenance practices, and an abundance of wild plants. At this particular nursery there were large sunburned plants of bishop's cap (Astrophytum myriostigma), devil's tongue (Ferocactus latispinus), and living rocks (Ariocarpus trigonus, A. retusus) in addition to other slow-growing

mature species. (An employee there said that it was a shame that I had not arrived sooner because I just missed the opportunity to go along with the owner who had departed on a collection trip!)

This area of the Rio Grande River valley seemed to suffer from the same economic depression affecting other agricultural areas in the United States. The cactus business seemed no exception. One nurseryowner bluntly told me that the cactus and succulent business was doing quite poorly and he even offered to sell his nursery to me.

Heading northwest, I reached the city of El Paso, situated further up the Rio Grande River valley where I visited five nurseries. Each carried cactus and succulent species, but only one specialized in them. This particular nursery sold many slow-growing, wild cacti. A woman at this nursery complained that in general business had been poor, although she told me that seed sales were quite good. The nursery derived its seed from its wild-collected plants. Surprisingly, the prices for these wild plants, such as mature specimens of living rock (Ariocarpus trigonus, A. kotschoubeyanus var. macdowellii), hedgehog cactus (Echinocereus triglochidiatus var. neomexicanus), horse cripplers (Homalocephala texensis), and many barrel cacti (Ferocactus spp.) were quite low.

New Mexico

As I traveled westward, I began to notice a subtle change in the species composition within nurseries. In nurseries of Arizona and New Mexico, I encountered large Sonoran desert species such as the giant saguaro (Carnegiea gigantea) and the large barrel cacti (Ferocactus spp.), rather than such genera as Astrophytum and Ariocarpus from the Chihuahuan desert in Texas and Mexico.

New Mexico, a sparsely populated state, has only a few cactus and succulent nurseries. Coincidently, native cactus diversity is less than in neighboring states; Benson (1982) claims that it has a total of 88 cactus taxa.

I visited two cactus and succulent nurseries in this state, one in the southern city of Deming, and another further north in Belen. The Deming nursery had a surprising variety of large Sonoran types, including many of the hedgehog species (Echinocereus spp.). I suspected that this nursery obtained many plants from nearby desert areas because of the large size and general appearance of its specimens. But the nursery was a small one that probably grew from a hobby into a business and it did not appear to represent a major threat to local native cacti.

In Belen, I interviewed cactophile Steven Brack, who also owns a modest nursery, and I found his approach to growing and collecting cacti unique. Brack emphasized that he keeps his plants under conditions most similar to those in situ. Although Brack has many wild-collected specimens, he has used a variety of techniques to produce seed-grown cacti that mimic wild ecotypes. He conscientiously runs his establishment more as a botanic garden than a commercial cactus nursery.

As a consultant to the U.S. Fish and Wildlife Service Endangered Species Program, Brack helped determine the status of the wild populations of North American Cactaceae. He is also familiar with collecting techniques practiced by many of the cactus and succulent nurserymen in the Southwest. He discussed with me how commercial collection takes place south of the border, explaining that many of the nurserymen do not collect the plants themselves. Instead, they develop contacts in Mexican villages who collect plants for them. The villagers who collect these plants may be paid as little as five cents (U.S.) per plant. The nurserymen receive the plants in Mexico, and then they secure safe passage across the U.S.-Mexico border for themselves and their cargo. As mentioned earlier, commercial collection and export of wild Mexican cacti is against Mexican law, so this activity places nurserymen in serious jeopardy. Brack and other nurserymen confirmed that the Mexican officials often accept bribes to issue proper permits for these illegal plant trafficking activities.

I was told that bribery in Mexico — commonly called "la mordida" — is a very risky business that places nurserymen in violation of other laws that carry severe penalties. According to Brack, some Mexican officials are quite capricious and will arrest unsuspecting nurserymen without warning, resulting in large fines, jail sentences, or, in some cases, even larger bribes.

Collecting Mexican cacti in this way hardly seems worth the risk of a jail term in Mexico. However, when a nurseryman successfully transports plants over the border it proves to be a relatively inexpensive way to obtain plants. It is possible this accounts for the low prices for wild-collected cacti that I observed during the survey.

Southern Arizona

Cacti are popular symbols for the state of Arizona, particularly the conspicuous tall saguaros and rotund barrel cacti. Arizona, according to Benson (1982), has 130 native cactus taxa.

Long-time residents of southern Arizona claim that the state's human population growth has increased dramatically, particularly after years when northern winters have been severe. Sun-starved immigrants from northern

states have converged upon this fragile desert area and the competition for prime desert real estate is intense. Consequently, the rapid growth of urban areas in Arizona greatly threatens Arizona's majestic cacti, although some nurserymen specialize in native plant rescue (see Lyons, this volume).

Southern Arizona's booming real estate market creates many opportunities for nurseries that specialize in native cacti and succulents for landscaping. Generally those that do not specialize in landscape cacti tend to carry substantial numbers of artificially-propagated cacti and other drought-resistant species to satisfy tourists and other cactus fanciers.

I visited five nurseries in Tucson, although there were many more in the vicinity that I did not have time to see. Not all of the nurseries I visited specialized in desert plants but all sold drought resistant species of pine, juniper, and other landscape specimens ideal for the dry Sonoran climate. I visited one nursery that had a special endangered species collection, although the owner indicated that none of these were for sale. There, I found a severed cephalium of a teddy-bear cactus (Backebergia militaris), along with other species such as hatchet cactus (Pelecyphora aselliformis), pinecone cactus (P. strobiliformis), Aztec cactus (Aztekium ritteri), artichoke cactus (Obregonia denegrii), and various Turbinicarpus species. I began to discover that most of these species are relatively rare in cultivation throughout the Southwest.

The landscaping business is one quite successful aspect of the cactus trade in the southern part of the state. I found several nurseries with large saguaros and barrel cacti for sale. These large cacti often decorate residential and commercial areas. Cactus landscapers relocate many plants threatened by home construction and other commercial development, particularly in areas that contain high densities of saguaros and barrel cacti.

By employing their own form of ex situ conservation, landscapers help conserve the fragile desert flora. The best conservation measure, however, is in situ. Proper in situ conservation requires careful land management and designation of more land as parks, monuments, and reserves if Arizona's unique and diverse plant life is to persist.

Southern Arizonan nurserymen appeared to be observing the native plant laws of their state. According to Article 6 of the Arizona Native Plant Law, all protected plants in cultivation that are taken from the wild, must bear specific tags that signify the approval of the Commission. And, in all nurseries I visited, it appeared that proper tags were affixed to native plants. The Arizona Commission of Agriculture and Horticulture oversees all native plant business in the state here and enforces such laws through nursery inspections and fines, which probably discourage most nurserymen from selling illegal plants. The maximum civil penalty for violation of the Native Plant Law is a $5,000 fine.

Southern California

Surprisingly, California, with its vast desert area, has fewer native cactus taxa than any of the previous three states. Benson (1982) recognizes a total of only 57 native taxa in the state.

As one of the most prosperous states in the nation, California has a thriving nursery business. Southern California nurseries produce the greatest numbers of artificially-propagated cactus plants in this country. The region is essentially a "grower's paradise" because of its warm climate and relatively moist coastal environment. The southern Pacific coastal climate, where most cacti and succulents are raised, differs greatly from that of the inland desert regions. In the Sonoran and Chihuahuan deserts, the summers are relatively wet and the winters are extremely dry, but along the coast the winters are wet and the summers dry. This phenomenon apparently has a positive effect upon the cactus and succulent business -- southern California growers probably produce more cactus biomass than the growers in the other three states combined.

California cactus growers claim that 99 percent of all U.S. trade in cacti and succulents is in artificially-propagated material. Most of these plants originate from California-grown seeds. Although U.S. growers do not have an exact estimate for total cactus production, most agree that it is in the range of of 10 to 50 million plants per year. Ingenius California growers have perfected propagating techniques and have turned their cacti into a substantial cash crop. ESA and CITES restrictions may be somewhat responsible for their success since import and export permits are easier to obtain for propagated material. Growers claim that it is simply not profitable to sell large amounts of collected wild plants because they could not meet the huge consumer demand by doing so.

The capabilities of these California growers surpassed those of most other growers I visited. Their business sense and their desire for profit seemed acute, and I heard a great deal of talk about "millionaire cactus nurserymen."

I visited a total of seven nurseries in the Vista, California area and was told that this town was the center of the heaviest cactus production area in the country (Cooper, pers. comm.). John Cooper, a prominent Vista grower and President of the California Cactus Grower's Association, estimated that in 1981 there were 22 million cacti and succulents in production in Vista alone. He claimed that thousands or even millions more were in production in 1984, although he had not produced a final estimate for the year.

These high production estimates show that not all cactus species are slow growing. In fact, contrary to popular belief, many cactus species grow quickly. California growers subject plants to intensive artificial selection and continue to increase plant-growing efficiency by selecting precocious cultivars with more desirable flowers, spines, and trichomes. These growers have demonstrated that they can produce more attractive plants from seed than are available in the wild, although some are well aware of the benefits of using wild plants for breeding.

I asked to see wild-collected plants within the collections of several of the larger California nurseries. Most nurserymen openly displayed their wild plants, but also most denied any current involvement in wild-plant commerce. They reminded me that collectors who obtained wild plants often did so long before the plants were legally protected. (Still, this trade has had lasting effects upon wild populations.) The growers used wild plants for a variety of purposes. Some simply had grown fond of them and used them for showpieces, others frequently took cuttings from them to produce vegetative clones, and most took advantage of their breeding potential and seed production.

In Tarzana, north of Los Angeles, I spoke with Ed Gay, a renowned plant explorer, collector, and nurseryman, about the effects of collection on wild populations and the status of Mexican and South American species. Gay informed me that collection of wild plants is falsely perceived as a problem. He explained that the expense and challenge of collecting isolated species tends to deter collectors from making extended journeys into the deserts and most collectors rarely make the effort to venture more than a short distance from the side of the highway. He emphasized that most Mexican and South American desert regions are virtually unexplored. On the other hand, Gay freely admitted that collection is a problem for certain target species. He cited the case of Lindsay's cactus (Echinocereus lindsayi), which collectors extirpated in Baja California shortly after its location was published in 1975.

Conclusion

This account summarizes the findings of nursery survey and the information that the nurserymen conveyed to me. I visited 30 different nurseries and traveled for two and one-half weeks over many miles of terrain. I would like to stress that there were many nurseries that I was unable to visit and opportunities to interview other collectors and growers that I undoubtedly missed. In a short space of time, I obtained a modest sample of current trends, facts, and views on the U.S. cactus and other succulent trade.

There are still problems surrounding the cactus trade, but the situation

is far better than it was before the enactment of ESA and CITES. Heavy trade in slow-growing Mexican endemics prevails but, hopefully, some of the controversy surrounding Mexican species' biological and legal status will be cleared up by the new IUCN Species Survival Commission (SSC) Cactus and Succulent Specialist Group. The SSC group, centered in Mexico, will carry out extensive population studies and training to help resolve some of the issues of cactus collection.

Based on my experience from several months of market and trade analysis, I recommend the following action regarding cactus and succulent conservation policy:

1) USDA officials should conduct random inspections of growing facilities (as set forth in the Federal Register, Vol. 49, No. 208) to determine if growers are propagating or are selling wild material. This information will be useful for determining whether permittees are abiding by the guidelines of CITES and ESA (Ford, 1984).

2) Both governmental and non-governmental endangered species specialists should work together to selectively delist or downlist cactus and succulent taxa that are widely and easily cultivated, and traded solely as artificially-propagated specimens.

3) Permit applicant fees for seeds of CITES-listed species should be reduced or eliminated. High fees discourage export and import of seeds and, consequently, the propagation of rare species.

4) The USDA and the U.S. Department of Interior (USDI) should continue to work in conjunction with the Department of State to clarify the legal status of U.S. plant imports from Mexico. If this cannot be done and permits have not been standardized, the U.S. should pursue an import ban on wild Mexican species.

5) The U.S. Fish and Wildlife Service and USDA should investigate the nurseries and collectors who have allegedly violated CITES and ESA by trading, selling, and propagating protected species without permits (Fuller, 1985). In the past, these activities have been a low priority for enforcement agencies. Enforcement personnel should step up efforts to stop illegal trade in protected species.

Information on Relative Abundance

Perhaps the most valuable information gathered during my travels and subsequent correspondence with growers is presented in the following list of the relative abundance of cacti and succulents in cultivation (Appendix).

This information is largely lacking in current horticultural literature.

Categories of "scarce," "generally available," and "very common" used here are relative measures corresponding to what I observed and gathered from firsthand information from experienced growers. Although it is not a complete list of the cultivated Cactaceae, I hope that it serves a useful purpose for cactus and succulent enthusiasts, law enforcement personnel, and all persons involved with the business of cacti.

I would like to thank John Cooper (Cooper's Cactus), Ed Gay (Cactus Ranchito), Dave Grigsby (Grigsby Cactus Gardens), Gil Tegelberg (Tegelberg's Cactus), and Woody Minnich (Cactus Data Plants) for helping me assemble this list.

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Appendix
A Sample of Cactus Species in Commercial Cultivation in the U.S., 1984

Scientific name	Relative abundance: Very common	Generally available	Scarce
Acanthocalycium glaucum		*	
Acanthocalycium peitscherianum			*
Acanthocalycium violaceum	*		
Acanthocereus pentagonus	*		
Aporocactus flagelliformis	*		
Ariocarpus agavoides		*	
Ariocarpus fissuratus		*	
Ariocarpus kotschoubeyanus		*	
Ariocarpus scapharostrus			*
Ariocarpus retusus		*	
Ariocarpus trigonus			*
Arrojadoa aureispina			*
Arrojadoa dinae			*
Arrojadoa eriocaulis			*
Arrojadoa pencillata	*		
Arthrocereus campos-portoi			*
Arthrocereus mirabilis		*	
Arthrocereus rondonianus			*
Astrophytum asterias	*		

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A Sample of Cactus Species in Commercial Cultivation in the U.S., 1984

Scientific name	Relative abundance: Very common	Generally available	Scarce
Astrophytum capricorne	*		
Astrophytum myriostigma	*		
Astrophytum ornatum	*		
Austrocephalocereus albicephalus		*	
Austrocephalocereus dybowskii		*	
Aztekium ritteri			*
Azureocereus herlingianus			*
Blossfeldia liliputana			*
Borzicactus aurantiacus		*	
Borzicactus aureiflorus		*	
Borzicactus aureispinus	*		
Borzicactus celsianus		*	
Borzicactus dolezianus		*	
Borzicactus fossulatus			*
Borzicactus hendricksenianus		*	
Borzicactus icosagonus		*	
Borzicactus madisoniorum	*		
Borzicactus myriacanthus			*
Borzicactus paucicostatus			*

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A Sample of Cactus Species in Commercial Cultivation
in the U.S., 1984

Scientific name	Relative abundance: Very common	Generally available	Scarce
Borzicactus ritteri			*
Borzicactus roseiflorus			*
Borzicactus sericatus		*	
Borzicactus trollii	*		
Buiningia aurea	*		
Buiningia brevicylindrica		*	
Carnegiea gigantea	*		
Cephalocereus chrysacanthus		*	
Cephalocereus maxonii			*
Cephalocereus palmeri	*		
Cephalocereus senilis	*		
Cereus azureus		*	
Cereus dayamii	*		
Cereus forbesii		*	
Cereus jamacaru	*		
Cereus peruvianus	*		
Chamaecereus silvestrii	*		
Cleistocactus strausii	*		
Coleocephalocereus fluminensis			*
Coleocephalocereus goebelianus			*

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A Sample of Cactus Species in Commercial Cultivation in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Copiapoa cinerea		*	
Copiapoa coquimbana			*
Copiapoa cupreata		*	
Copiapoa echinoides			*
Copiapoa fiedlerana			*
Copiapoa grandiflora			*
Copiapoa humilis	*		
Copiapoa hypogaea			*
Copiapoa megarhiza			*
Copiapoa pendulina		*	
Coryphantha andreae			*
Coryphantha bumamma		*	
Coryphantha calipensis		*	
Coryphantha clava		*	
Coryphantha cornifera			*
Coryphantha emskoetteriana			*
Coryphantha greenwoodii		*	
Coryphantha palmeri		*	
Coryphantha radians	*		
Coryphantha retusa		*	

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A Sample of Cactus Species in Commercial Cultivation in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Coryphantha sulcolanata		*	
Cryptocereus anthonyanus		*	
Denmoza rhodacantha		*	
Discocactus heptacanthus			*
Discocactus horstii		*	
Discocactus placentiformis			*
Discocactus zehntneri		*	
Echinocereus chloranthus		*	
Echinocereus cinerascens		*	
Echinocereus delaetii		*	
Echinocereus engelmannii		*	
Echinocereus fendleri	*		
Echinocereus gentryi	*		
Echinocereus grandis			*
Echinocereus hempelii			*
Echinocereus knippelianus	*		
Echinocereus longisetus		*	
Echinocereus maritimus		*	
Echinocereus morricallii		*	
Echinocereus nivosus		*	

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Scientific name	Relative abundance: Very common	Generally available	Scarce
Echinocereus pectinatus	*		
Echinocereus pentalophus		*	
Echinocereus reichenbachii		*	
Echinocereus russanthus	*		
Echinocereus salm-dyckianus		*	
Echinocereus sciurus		*	
Echinocereus stramineus			*
Echinocereus subinermis		*	
Echinocereus tayopensis	*		
Echinocereus triglochidiatus		*	
Echinocereus viridiflorus			*
Echinocereus websterianus		*	
Echinomastus intertextus			*
Echinomastus unguispinus			*
Echinopsis ancistrophora	*		
Echinopsis bridgesii			*
Echinopsis mamillosa	*		
Echinopsis obrepanda			*
Echinopsis subdenudata		*	
Eriosyce ceratistes			*

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A Sample of Cactus Species in Commercial Cultivation
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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Escobaria dasyacantha		*	
Escobaria elephantidens		*	
Escobaria hesteri		*	
Escobaria strobiliformis			*
Escobaria vivipara			*
Escobaria zilziana	*		
Espostoa huanucensis			*
Espostoa lanata		*	
Espostoa laticornua			*
Espostoa nana	*		
Espostoa ritteri		*	
Ferocactus bicolor			*
Ferocactus covillei	*		
Ferocactus cylindraceus	*		
Ferocactus diguettii		*	
Ferocactus glaucescens		*	
Ferocactus gracilis		*	
Ferocactus haematacantus		*	
Ferocactus hamatacantus	*		
Ferocactus herrerae		*	

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A Sample of Cactus Species in Commercial Cultivation
in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Ferocactus heterochromus			*
Ferocactus histrix		*	
Ferocactus latispinus	*		
Ferocactus macrodiscus	*		
Ferocactus peninsulae	*		
Ferocactus rectispinus		*	
Ferocactus recurvus	*		
Ferocactus schwarzii			*
Ferocactus setispinus	*		
Ferocactus townsendianus			*
Ferocactus uncinatus		*	
Ferocactus wislizeni	*		
Frailea asterioides		*	
Frailea chiquitana		*	
Frailea knippeliana			*
Frailea pumila			*
Frailea pygmaea		*	
Frailea schilinzkyana		*	
Gymnocactus beguinii			*
Gymnocactus horripilus			*

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A Sample of Cactus Species in Commercial Cultivation
in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Gymnocactus mandragora			*
Gymnocactus saueri			*
Gymnocalycium andreae		*	
Gymnocalycium baldianum	*		
Gymnocalycium bicolor			*
Gymnocalycium bodenbenderianum			*
Gymnocalycium bruchii	*		
Gymnocalycium calochlorum		*	
Gymnocalycium capillaense			*
Gymnocalycium cardenasianum		*	
Gymnocalycium chiquitanum		*	
Gymnocalycium comarapense			*
Gymnocalycium damsii	*		
Gymnocalycium denudatum	*		
Gymnocalycium eurypleurum		*	
Gymnocalycium gibbosum		*	
Gymnocalycium horridispinum		*	
Gymnocalycium horstii		*	
Gymnocalycium leeanum		*	
Gymnocalycium megatae		*	

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Gymnocalycium mihanovichii	*		
Gymnocalycium monvillei		*	
Gymnocalycium moserianum			*
Gymnocalycium mostii			*
Gymnocalycium multiflorum		*	
Gymnocalycium pflanzii		*	
Gymnocalycium pungens		*	
Gymnocalycium quehlianum			*
Gymnocalycium ragonesii		*	
Gymnocalycium saglione	*		
Gymnocalycium schickendantzii		*	
Gymnocalycium spegazzinii		*	
Gymnocalycium stellatum		*	
Gymnocalycium uebelmannianum			*
Gymnocalycium uruguayense			*
Gymnocalycium valnicekianum		*	
Gymnocalycium vatteri			*
Haageocereus aureispinus		*	
Helianthocereus herzogianus		*	
Helianthocereus pasacana		*	

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Heliocereus speciosus			*
Homalocephala texensis		*	
Lepidocoryphantha macromeris		*	
Leuchtenbergia principis	*		
Lobivia aurea		*	
Lobivia backebergii		*	
Lobivia chrysantha			*
Lobivia cinnabarina			*
Lobivia famatimensis			*
Lobivia maximiliana			*
Lobivia pampana			*
Lobivia pentlandii			*
Lobivia tiegeliana			*
Mammillaria albicans		*	
Mammillaria albicoma	*		
Mammillaria albilanata	*		
Mammillaria angelensis		*	
Mammillaria armillata		*	*
Mammillaria aureilanata		*	
Mammillaria aurihamata			*

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Mammillaria backebergiana			*
Mammillaria barbata			*
Mammillaria baxteriana			*
Mammillaria beneckei			*
Mammillaria blossfieldiana	*		
Mammillaria bocasana	*		
Mammillaria bocensis		*	
Mammillaria bombycina	*		
Mammillaria boolii		*	
Mammillaria brandegei			*
Mammillaria candida		*	
Mammillaria canelensis			*
Mammillaria capensis			*
Mammillaria carmenae		*	
Mammillaria carnea		*	
Mammillaria carrettii			*
Mammillaria chionocephala			*
Mammillaria coahuilensis		*	
Mammillaria columbiana	*		
Mammillaria compressa		*	

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Mammillaria crucigera		*	
Mammillaria decipiens	*		
Mammillaria deherdtiana		*	
Mammillaria densispina		*	
Mammillaria dioica		*	
Mammillaria discolor	*		
Mammillaria dixanthocentron	*		
Mammillaria elongata	*		
Mammillaria eriacantha			*
Mammillaria fittkaui			*
Mammillaria formosa			*
Mammillaria fraileana		*	
Mammillaria geminispina	*		
Mammillaria gigantea		*	
Mammillaria glassii	*		
Mammillaria goodridgii			*
Mammillaria grusonii			*
Mammillaria guelzowiana		*	
Mammillaria haageana	*		

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Scientific name	Relative abundance: Very common	Generally available	Scarce
Mammillaria hahniana	*		
Mammillaria heidiae			*
Mammillaria hertichiana		*	
Mammillaria heyderi		*	
Mammillaria huitzilopochtli		*	
Mammillaria humboldtii		*	
Mammillaria insularis			*
Mammillaria jaliscana			*
Mammillaria johnstonii		*	
Mammillaria karwinskiana		*	
Mammillaria klissingiana		*	
Mammillaria kraehenbuehlii		*	
Mammillaria kunzeana			*
Mammillaria lasiacantha			*
Mammillaria laui			*
Mammillaria lenta			*
Mammillaria leucantha	*		
Mammillaria lindsayi			*
Mammillaria longimamma	*		
Mammillaria magallanii			*

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A Sample of Cactus Species in Commercial Cultivation
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Scientific name	Relative abundance: Very common	Generally available	Scarce
Mammillaria magnifica		*	
Mammillaria magnimamma	*		
Mammillaria mainiae			*
Mammillaria marksiana			*
Mammillaria mathildae			*
Mammillaria matudae	*		
Mammillaria mazatlanensis		*	
Mammillaria melanocentra	*		
Mammillaria mercadensis		*	
Mammillaria meyranii			*
Mammillaria microcarpa			*
Mammillaria microhelia	*		
Mammillaria microthele			*
Mammillaria miegiana			*
Mammillaria moelleriana			*
Mammillaria muehlenpfordtii		*	
Mammillaria multidigitata			*
Mammillaria mystax	*		
Mammillaria nana		*	
Mammillaria napina			*

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A Sample of Cactus Species in Commercial Cultivation
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Scientific name	Relative abundance: Very common	Generally available	Scarce
Mammillaria neopalmeri			*
Mammillaria nunezii		*	
Mammillaria occidentalis			*
Mammillaria oteroi			*
Mammillaria painteri			*
Mammillaria parkinsonii	*		
Mammillaria pectinifera			*
Mammillaria peninsularis			*
Mammillaria pennispinosa		*	
Mammillaria perbella			*
Mammillaria petterssonii			*
Mammillaria phitauiana			*
Mammillaria picta			*
Mammillaria pilispina			*
Mammillaria plumosa	*		
Mammillaria polythele			*
Mammillaria pondii		*	
Mammillaria poselgeri		*	
Mammillaria prolifera		*	
Mammillaria rekoi			*

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Mammillaria rhondantha	*		
Mammillaria roseoalba			*
Mammillaria rubrograndis	*		
Mammillaria saboae			*
Mammillaria schiedeana		*	
Mammillaria schumannii	*		
Mammillaria schwarzii	*		
Mammillaria scrippsiana			*
Mammillaria sempervivi			*
Mammillaria sheldonii			*
Mammillaria sinistrohamata			*
Mammillaria solisioides			*
Mammillaria sonorensis			*
Mammillaria sphacelata			*
Mammillaria sphaerica			*
Mammillaria spinosissima		*	
Mammillaria standleyi			*
Mammillaria supertexta			*
Mammillaria swinglei			*
Mammillaria tayloriorum			*

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Mammillaria theresae	*		
Mammillaria thornberi		*	
Mammillaria uncinata			*
Mammillaria vetula			*
Mammillaria viridiflora			*
Mammillaria voburnensis		*	
Mammillaria wiesingeri			*
Mammillaria wildii	*		
Mammillaria wrightii	*		
Mammillaria xaltianguensis	*		
Mammillaria zacatecasensis	*		
Mammillaria zeilmanniana	*		
Mammillaria zephyranthoides		*	
Melocactus azureus		*	
Melocactus broadwayii			*
Melocactus delessertianus		*	
Melocactus glaucesens			*
Melocactus levitestatus		*	
Melocactus matanzanus	*		
Melocactus maxonii			*

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Scientific name	Relative abundance: Very common	Generally available	Scarce
Melocactus oreas		*	
Melocactus violaceus			*
Monvillea spegazzinii		*	
Myrtillocactus eichlamii			*
Myrtillocactus geometrizans	*		
Neobuxbaumia euphorbioides		*	
Neobuxbaumia mezcalaensis			*
Neobuxbaumia polylopha	*		
Neobuxbaumia tetetzo			*
Neolloydia conoidea			*
Neolloydia erectocentrus			*
Neolloydia grandiflora	*		
Neolloydia mariposensis			*
Neoporteria bulbocalyx		*	
Neoporteria calderana			*
Neoporteria calvata			*
Neoporteria chilensis			*
Neoporteria coimasensis			*
Neoporteria confinis			*
Neoporteria curvispina			*

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Neoporteria dimorpha			*
Neoporteria eriosyzoides			*
Neoporteria fusca			*
Neoporteria hankeana		*	
Neoporteria islayensis			*
Neoporteria kunzei			*
Neoporteria laniceps	*		
Neoporteria lindleyi			*
Neoporteria marksianus			*
Neoporteria nidus	*		
Neoporteria occulta		*	
Neoporteria paucicostata			*
Neoporteria pilispina			*
Neoporteria residua			*
Neoporteria rupicola			*
Neoporteria subgibbosa	*		
Neoporteria taltalensis			*
Neoporteria tuberisulcata			*
Neoporteria umadeave			*
Neoporteria villosa			*

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Neoraimondia roseiflora			*
Nopalea dejecta			*
Notocactus acutus			*
Notocactus arachnitis			*
Notocactus arechavaletai			*
Notocactus bommeljeii			*
Notocactus buiningii	*		
Notocactus carambiensis		*	
Notocactus claviceps	*		
Notocactus cocinnus			*
Notocactus corynodes			*
Notocactus crassigibbus	*		
Notocactus erinaceus			*
Notocactus floricomus		*	
Notocactus fuscus			*
Notocactus glaucinus			*
Notocactus graessneri	*		
Notocactus haselbergii	*		
Notocactus herteri	*		
Notocactus horstii	*		

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Scientific name	Relative abundance: Very common	Generally available	Scarce
Notocactus leninghausii	*		
Notocactus magnificus	*		
Notocactus mammulosus	*		
Notocactus magapotamicus			*
Notocactus mueller-moelleri		*	
Notocactus nigrispinus		*	
Notocactus ottonis	*		
Notocactus purpurpeus	*		
Notocactus rauschii			*
Notocactus roseoluteus			*
Notocactus rutilans			*
Notocactus schlosseri		*	
Notocactus schumannianus		*	
Notocactus scopa	*		
Notocactus sellowii			*
Notocactus sessiliflorus			*
Notocactus submammulosus	*		
Notocactus sucineus		*	
Notocactus tenuicylindricus			*
Notocactus uebelmannianus	*		

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Notocactus vanvlietii	*		
Notocactus warasii		*	
Notocactus werdermannianus	*		
Obregonia denegrii		*	
Opuntia basilaris			*
Opuntia elata			*
Opuntia lindheimeri			*
Opuntia microdasys		*	
Opuntia vulgaris		*	
Oroya borchersii			*
Oroya peruviana			*
Oroya subgibbosa			*
Pachycereus marginatus	*		
Pachycereus pecten-aboriginum	*		
Pachycereus pringlei	*		
Parodia aureispina	*		
Parodia cardenasii		*	
Parodia chrysacanthion		*	
Parodia comosa			*
Parodia dichroacantha			*

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Parodia formosa			*
Parodia laui			*
Parodia maassii		*	
Parodia mairanana		*	
Parodia microsperma		*	
Parodia mutabilis		*	
Parodia nivosa		*	
Parodia ocampoi		*	
Parodia pencillata			*
Parodia schwebsiana			*
Parodia uebelmanniana			*
Parodia variicolor			*
Pediocactus knowltonii			*
Pediocactus peeblesianus			*
Pelecyphora aselliformis			*
Pelecyphora strobiliformis			*
Pilosocereus bradei		*	
Pilosocereus gounellei		*	
Pilosocereus magnificus		*	
Pilosocereus pentaedrophorus		*	

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Rebutia albipilosa	*		
Rebutia albopectinata		*	
Rebutia cajasensis	*		
Rebutia chrysacantha			*
Rebutia cintiensis	*		
Rebutia deminuta	*		
Rebutia fiebrigii	*		
Rebutia flavistyla		*	
Rebutia fusca		*	
Rebutia heliosa	*		
Rebutia hoffmannii		*	
Rebutia huasiensis		*	
Rebutia kieslingii			*
Rebutia krainziana		*	
Rebutia kupperiana	*		
Rebutia mamillosa			*
Rebutia marsoneri		*	
Rebutia minuscula	*		
Rebutia narvaecensis			*
Rebutia nitida	*		

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Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Rebutia padcayensis			*
Rebutia pseudodeminuta	*		
Rebutia pulvinosa	*		
Rebutia pygmaea			*
Rebutia robustispina		*	
Rebutia sanguinea	*		
Rebutia senilis		*	
Rebutia spegazziniana	*		
Rebutia spinosissima		*	
Rebutia steinmannii			*
Rebutia tamboensis		*	
Rebutia wessneriana			*
Rebutia xanthocarpa			*
Rhipsalis cereuscula			*
Rhipsalis cruciformis		*	
Rhipsalis gaertneri		*	
Rhipsalis ianthothele			*
Rhipsalis monacantha		*	
Rhipsalis warmingiana			*
Schlumbergera truncata		*	

Appendix
A Sample of Cactus Species in Commercial Cultivation in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Selenicereus grandiflorus			*
Stenocactus hastatus		*	
Stenocactus kellerianus			*
Stenocactus lamellosus			*
Stenocactus lloydii		*	
Stenocactus multicostatus	*		
Stenocactus ochoterenaus		*	
Stenocactus vaupelianus		*	
Stenocactus violaciflorus			*
Stenocactus zacatecasensis		*	
Stenocereus bustamantei		*	
Stenocereus coptonogonus		*	
Stenocereus dumortieri	*		
Stenocereus stellatus		*	
Stephanocerus leucostele			*
Stetsonia coryne			*
Sulcorebutia alba			*
Sulcorebutia arenacea		*	
Sulcorebutia candiae			*
Sulcorebutia canigueralii			*

Appendix
A Sample of Cactus Species in Commercial Cultivation
in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Sulcorebutia crispata		*	
Sulcorebutia flavissima			*
Sulcorebutia frankiana			*
Sulcorebutia glomeriseta		*	
Sulcorebutia krahnii			*
Sulcorebutia lepida			*
Sulcorebutia markusii			*
Sulcorebutia menesesii		*	
Sulcorebutia mentosa			*
Sulcorebutia polymorpha		*	
Sulcorebutia steinbachii		*	
Sulcorebutia sucrensis			*
Sulcorebutia tarabucoensis			*
Sulcorebutia tarijensis		*	
Sulcorebutia tiraquensis			*
Sulcorebutia totrensis			*
Sulcorebutia vasqueziana			*
Thelocactus bicolor		*	
Thelocactus conothelos			*
Thelocactus hexaedrophorus			*

Appendix
A Sample of Cactus Species in Commercial Cultivation in the U.S., 1984

Scientific name	Relative abundance: Very common	Generally available	Scarce
Thelocactus matudae			*
Thelocactus rinconensis			*
Thelocactus tulensis			*
Trichocereus bridgesii			*
Trichocereus candicans			*
Trichocereus chilensis			*
Trichocereus macrogonus			*
Trichocereus pachanoi		*	
Trichocereus spachianus	*		
Trichocereus thelegonus		*	
Trichocereus werdermannianus			*
Turbinicarpus pseudopectinatus			*
Turbinicarpus schmiedickeanus			*
Turbinicarpus valdezianus			*
Uebelmannia pectinifera		*	
Weberbauereocereus johnsonii			*
Weberbauereocereus weberbaueri			*
Weingartia lanata			*
Weingartia longigibba			*
Weingartia neocumingii		*	

Appendix
A Sample of Cactus Species in Commercial Cultivation
in the U.S., 1984

Scientific name	Relative abundance		
	Very common	Generally available	Scarce
Weingartia riograndensis			*
Wilcoxia albiflora			*
Wilcoxia schmollii		*	
Wilcoxia tamaulipensis			*
Wittia amazonica		*	

Landscaping with Extinction

Gary Lyons*

Introduction

Gardens of cacti and other succulents weave in the discerning eye a multitude of forms and textures, both bizarre and beautiful. Such a scene, whether it is a formal botanical garden, a tiny residential planter, or a sprawling commercial landscape, suggests an awareness of the beauty of the surrounding environment. However, my experience as a landscape gardener and grower of succulent plants made me examine the U.S. landscape business more critically. I learned that using cacti and other succulents for authentic looking "desertscapes" often meant uprooting them from their native habitats, rather than selecting them from commercial seed and cutting stock.

Standard landscape succulents such as saguaro (Carnegiea gigantea), joshua tree (Yucca brevifolia), ocotillo (Fouquieria splendens), barrel cacti (Ferocactus and Echinocactus spp.), cholla and prickly pear cacti (Opuntia spp.), and many other succulents (see Appendix), are often dug from the wild as mature or nearly mature plants. These succulents are removed because it is relatively convenient and inexpensive to do so or, unfortunately, because they are unavailable as artificially-propagated stock grown for landscaping. The net result is that collection endangers many species and often causes in high plant mortality. Even those plants that are successfully transplanted often do not survive after transplanting.

Many so-called "cactus wranglers" who supply wild-collected material lack knowledge of the plants' horticultural needs and limitations in adapting to new environments. Their role in the native plant industry is often analogous to one who catches wild animals for zoos and pet stores: meeting the horticultural requirements of wild-collected plants can be just as difficult to achieve as adjusting a captured wild animal to life in captivity.

In addition, collection is not adequatedly regulated. Although state-controlled permit systems have been established to allow removal of useful desert plant species, a practice sanctioned with the purchase of a tag at a small fee (in Arizona, for example, a saguaro tag costs $3.00), requirements for removal generally include payment of the permit fee, receipt of landowner's permission to remove plants, and the use of mechanical equipment for moving heavy plants.

These few plant species, which contribute so much to the unique character of the desert southwest, are also threatened by the development of water resources and urban expansion. Therefore, there is a great need to turn away from the

* Mr. Lyons' current address is 2604 W. Clark Ave, Burbank, CA 91505.

traditional view that the desert flora is exploitable for landscape purposes and to seek a horticultural approach to succulent plant conservation.

Transplanting in California

When I began working at the Huntington Botanical Gardens in southern California, I recognized the difficulties my predecessors had with native succulents. In 1912, William Hertrich, the Desert Garden's original designer, added several railroad carloads of native Arizona cacti. Among them were numerous small saguaros (referred to in the trade as "spears") ranging from three to twelve feet in height. They were planted with good drainage on a south facing slope and exposed to full sun. Early photos of the saguaro exhibit indicated that the display differed little from current landscaping techniques used throughout the desert southwest. By 1965, however, only two sickly saguaros remained. To the best of my knowledge, disease and the absence of a desert environment were the primary factors causing these two plants to remain nearly the same size since 1912. But there were some noticeable changes: one specimen, over five feet tall, went through a fifty-plus year struggle to push up a two-inch sprout of "garden growth" at the shoot apex; in the other saguaro there was no growth at all. In the wild, saguaros in this size range would produce two to seven inches of healthy growth per year.

Many cacti native to the desert southwest (excluding most Opuntia spp.) do not transplant well to the damper, poorly-drained soils of coastal southern California. Also, collected cacti do not respond well to reduced sunlight levels; desert sunlight is invariably bright, while coastal and non-desert regions — such as Los Angeles -- often have weeks without direct sunlight. In cities like Los Angeles, smog, haze, tall buildings, and tree-filled landscapes contribute to reduced light intensity. This fact and the Huntington experience led me to avoid landscaping with most southwest species and utilize succulents of a more temperate origin.

Problems with Desert Horticulture in Nevada

In 1981, I undertook the task of designing and planting a botanical garden in southern Nevada's Mojave Desert. By using succulents native to the southwest states, I learned the complexities of desert landscape horticulture. I experienced a series of frustrating events when working with plants that were subjected to transplantation stress and climatic extremes. For example, when a fresh shipment of drought-tolerant trees and shrubs, unloaded into an air temperature of 118 degrees F began dying within thirty minutes, it was clear that southern California desert horticultural techniques were inadequate to maintain plants under these hostile conditions.

Desert cacti must withstand great temperature fluctuations, high average wind

speeds, sand and dust whirlwinds, soil toxicity, and a lack of soil nutrients. Under such conditions, nursery-grown specimens from southern California's gentle climate would be badly sunburned. There were simply no artificially-propagated succulents available that could be used for desert landscaping except offsets of some species of prickly pear and cholla (Opuntia spp.), yucca (Yucca spp.), and agave (Agave spp.).

As planting commenced, it became clear that the southern Nevada desert was significantly different from that in central Arizona, where I obtained most of my landscape specimens. Central Arizona is the location of much of habitat from which so many of the useful landscape plants are harvested. Las Vegas, on the other hand, is much drier, without the summer rainfall that defines the saguaro distribution, and is very windy. Initially, I worried about saguaros' survival in this section of the Mojave Desert, but other landscapers and designers used them for years and their popularity was increasing. The specimens used were usually spears or had very short branches and were found only in residential projects. As part of this undertaking, I visited local Las Vegas nurseries specializing in cacti and I concluded that there was little knowledge of the cultural needs of these plants. For such dealers, growing native cacti and other succulents seemed to be more a matter of trial and error than expertise. These nurserymen often collected from nearby areas in order to provide healthy material for landscape projects.

In my travels I also discovered that copper mining is a significant threat to saguaros when a Tucson dealer showed me a mine where he had successfully bid on land to be used as a mining dump. This site was the source of some of my selected saguaros as was nearby Bureau of Land Management (BLM) ranchland. As we pulled up to the edge of the dump, I stared in stunned silence at a denatured sea of bluish-gray waste, perhaps twenty acres or more in extent, that appeared to be gradually expanding and enveloping the native vegetation. Only the tops of once giant saguaros were visible and near the center was a small island dotted with a handful of saguaro refugees that lingered as a last testament of the once luxuriant Sonoran desert flora. At that moment I wanted to call the whole thing off, pack up, and return to California. But my curiosity prevailed and I accepted this as the reality of salvage horticulture. Once again, I compelled myself to resume the role of customer/designer serving the needs of a client. The nurseryowner agreed to remove only those specimens useful for trade. He had two years to remove the plants and the remainder (actually most of them) would be bulldozed or destroyed by the toxic fill.

My Las Vegas client gave orders to commence planting of the desert garden no later than June 15. Summer would arrive weeks before that date, and I was very concerned about the effect of heat and intense sunlight on field-collected cacti, especially those imported from other states. Mid-June was the hottest period of the year, when most horticulturists stop all planting, but my client insisted on

opening the garden to the public as soon as possible.

On the day the Tucson saguaros arrived, despite constant wind, the air temperature quickly rose to 118 degrees. I knew that heat and low humidity could result in serious damage to unprotected cacti. The actual planting required a truck equipped with a hydraulic cradle and winch, plus a crew of three men. The hydraulic cradle was indispensible for planting the larger specimens while the winch swung the spears off the side of the truck before they were muscled into the ground. Since the dealer was anxious to get back to his nursery in Tucson, he lost little time getting the saguaros off the truck and into the ground. One by one he swung the spears from the truck into the holes and quickly compassed. (Compassing simply assures that the same side of the plant is exposed to sunlight in its new location as it was in the wild. Thus, the toughest side of the plant is exposed to intense desert sunlight. If the weaker side is exposed, it could result in serious sunburn and death of the plant. This is especially critical for the larger saguaros, whether they are transplanted within or beyond their range.) He used no fertilizer and was satisfied putting the plants into sterile soil.

After the cactus supplier departed for Tucson, I struggled to save the newly-planted cacti. Within two hours of planting, the saguaros began burning from western exposure. Compassing did not protect them from the vicious Las Vegas sun. I located some shade cloth and draped it over all the plants. With each saguaro sporting a black shroud, it made the project appear as an assemblage of ghostly figures rather than a garden.

Miraculously, every plant except one survived the duration of that unusually hot summer. All specimens were checked regularly for rot or any unusual change in the stem. One plant rotted at the base, but a bit of tree surgery saved it. As expected, the specimens' stems shrivelled continually for months and by the end of the year only the smallest plants (3-4 ft) rooted. The taller spears showed no root activity for almost one year and some remained unrooted well after that, possibly because of the climate's severity.

During this period, rumors spread about the existence of the Las Vegas cactus garden and cactus wranglers soon paid me unexpected visits to sell new specimens. One such incident involved the arrival of two brothers towing a small caravan of saguaros and other native Arizona cacti. As I surveyed their plants, my eye caught the truck's open glove compartment, which contained numerous permit tags. It was my understanding that the permits belonged on the saguaros and other cacti, not inside the truck. Putting off any decision, I called Richard Countryman, head enforcement officer for the Arizona Commission of Horticulture and Agriculture at the time, and told him who I was dealing with. He was surprised to hear their names and informed me that they had just been released from jail. After this and similar incidents, I decided to avoid all truckers and wranglers, and buy only from a few established, reputable dealers.

I also planted a combination of southwest succulent flora, as well as specimens from Mexico and South America at the Las Vegas location. Some of the species planted were the densely-spined Ferocactus acanthodes, Echinocactus polycephalus, and Neolloydia johnsonii. These species proved to be among the hardiest, and occurred locally. Other species, native to Texas and northern Mexico, such as Homalocephala texensis, Echinocactus horizonthalonius, and Astrophytum myriostigma adapted poorly because of the intense sun. Agave victoriae-reginae was also sensitive to temperature extremes and suffered from severe stress. Unfortunately, the combined effects of environmental stress upon many field-collected plants resulted in a dramatic reduction of growth, cessation of root development, and, in many cases, death.

Hedgehog cacti, particularly Echinocereus engelmannii, suffered more from the ill-effects of harvesting from the wild than any other cacti. Apparently, this was due to clumsy collecting procedures. Usually, their roots were so badly crushed and mangled that they had to be removed; others had no roots at all, indicating the plant had been wrenched with great force from the ground. Hedgehog cacti, however, that survived beyond the first year adapted well, producing vigorous displays of spring flowers and healthy new growth.

Other Aspects of the Arizona Cactus Trade

The Arizona cactus trade is well known. It is relatively simple to get a truckload of collected plants delivered to the Las Vegas area from Arizona, where Phoenix and Tucson telephone directories list many dealers. I found that cactus diggers' horticultural advice consisted of cautioning clients (usually landscapers, builders, nurseries, home owners) not to water the plants for two to six months after receipt. Some might tell buyers how to check for rot. They also knew that saguaros must be compassed upon transplanting.

During numerous nursery visits in Arizona and Nevada, I also learned that any plant reference by Latin name was usually pointless. I rarely encountered a native cactus nursery dealer, digger, or supplier who had a good knowledge of scientific names. (Perhaps this explains why Arizona does not break down its protected cactus list into species and varieties, since very few commercial nurserymen would be able to identify them in the field.) This situation also applied to varieties which possess only slight morphological differences. I also noticed rare cacti for sale — some officially listed as threatened or endangered species — yet the dealers had little or no knowledge of their status. It seems that a formal listing of endangered species would be a weak sales deterrent because of nurserymen's ignorance of basic scientific nomenclature.

Overall, the difficulties of reestablishing saguaros led me to question the practice of distributing Arizona's protected plants beyond their natural range. But if they are to be distributed in this manner, precautions should be taken to

enhance their survival in environments to which they are not adapted.

Recent figures produced by the Arizona Commission of Agriculture and Horticulture show that the sanctioned removal of these plants continues. From 1984 to 1985, the Commission granted 1,135 permits for the removal of 6,492 saguaros, 881 joshua trees, 12,524 ocotillos, and 24,093 miscellaneous cacti. Mr. Larry Richards of the Commission recently indicated that shipments of cacti are being trucked from Texas to Arizona in quantities ranging from 20,000-40,000 plants each (Richards, pers. comm.). Most of these are probably destined for the collector trade, but some undoubtedly end up in the landscape market.

Unfortunately, scientific studies on transplant stress and longevity in cultivation appear to be lacking and little is known of the ecological effects of continuous harvesting on saguaros. Such studies would contribute to the improvement of saguaro and joshua removal techniques. One study has shown that the saguaro population around Tucson is unstable and declining possibly due to such factors as climatic changes, disease, and grazing on shrubs that provide shade (Steenbergh and Lowe, 1977).

Transplanting the Joshua Tree

The joshua tree (Yucca brevifolia), along with the saguaro, ocotillo, agave, and prickly pear, is one of the key elements of southwest desert landscaping. They are commonly seen as graceful tree-like forms accenting Mojave Desert gardens. But like the saguaro, the joshua's popularity as a landscape plant does not mean that it can be transplanted without problems. My experience suggests that the joshua tree is one of the most difficult desert plants to keep alive in cultivation.

There are several forms of Y. brevifolia, three representing recognized subspecies and two as population segregates without formal status. The species Y. brevifolia ssp. brevifolia is common to the western Mojave Desert and is found in California's Joshua Tree National Monument. There is also a gracile form found in northern Arizona, southern Utah, and Nevada that is less robust and shorter-leaved than the typical species. As far as I can determine, this population is not a recognized subspecies. Another distinct population, farther south in Arizona, consists of large trees with open branching and long silvery leaves. It, too, is regarded as Y. brevifolia. In southern California's eastern Mojave and in southern Nevada, is found Y. brevifolia spp. jaegerana, a dwarf form with compact branching and a dense armature of short stiff leaves. (Both this, and the gracile form, are the ones I worked with in landscaping.) Finally, in the northwestern Mojave, around Palmdale and Lancaster, California, is a rhizomatous form, of the subspecies herbertii.

The availability of joshuas was not as great as that of saguaros. One large cactus nursery in Las Vegas kept a modest supply of joshuas, mostly Y. brevifolia ssp. jaegerana. The nursery owner explained that he had a permit to salvage the yuccas from BLM land. In 1981, apparently, collecting permits were not granted at

all and salvage permits were only rarely granted. One official told me that she occasionally received requests for commercial harvest permits for joshuas, but that she personally would not grant such a permit and knew of no other BLM official who would do so.

The Las Vegas nursery harvested about 30 small to medium sized joshuas at a time. But is is difficult to handle joshua trees without damaging them. Unlike the lucrative saguaro trade, there are no mechanical devices to ease taking, hauling, and replanting. This situation restricts the size of joshuas selected for removal to small specimens.

Joshuas are seldom transported or utilized beyond their native habitats. Due to removal and transport difficulties, they are either planted in a nursery or removed from a site only when needed for a specific project. I have never observed them in secondary staging areas. Their vigorous appearance immediately after transplanting is deceptive, for it often gives the impression that the joshuas are healthy and well rooted, when in most cases they are nct.

Dealers and suppliers recognize joshuas as cool season plants; i.e., removal is best in early spring or late autumn. It is difficult to transport joshuas without leaf breakage, but judicious use of padding material could prevent this. Typically, small and medium-sized specimens (3-8 ft) with some branching are selected for landscaping. Large joshuas may cost up to $150-250 per plant due to the labor costs involved in transplanting. However, low survival rates may account for some of the low prices I observed.

Like saguaros, joshuas must be planted deep enough to give them the support once provided by their extensive root systems. In 1981, I planted some shallowly and used wires to prevent wind damage to newly-formed roots. I used a wide variety of approaches to reestablish joshua trees and most of the results were equally dismal. I overwatered, underwatered, misted the leaves, and added hormones, but all horticultural efforts failed to produce any predictable result except the death of the plant. The only factor that made any difference was the size; like saguaros, the smallest specimens seemed to show the best survival rates.

From 1981 to 1983, the transplanted joshua trees showed signs of growth and even flowered. But this did not last. Unfortunately, the leaves turned brown and the smaller branches shrivelled. There was also a conspicuous absence of new growth. The trees were originally planted in the fall and following spring to escape the destructive summer heat. In spite of this protective measure, the onset of summer quickly caused the leaves to become dessicated. The stems showed some signs of rot when I checked for the presence of roots. Eventually, most of the joshuas deteriorated to the point where the owner instructed us to dispose of them because they were in such poor condition.

Recommendations:
Transplant Techniques

Overall, native plant harvest is desirable when transplanted succulents can complete their normal life cycles in cultivation. But, as I have described, there is little assurance that succulent plants exported beyond their range — such as the saguaro and joshua — will survive.

The staff at the Desert Botanical Garden in Tempe, Arizona have developed techniques to ensure survival of transplanted saguaros. They water saguaros at approximately two-week intervals. This practice applies only to plants with healthy root systems. There are no studies to indicate exactly how and when rooting occurs or if rooting would even revive a badly dessicated specimen. If root production is a response to stress, then why not limit plant removal from habitat to periods of water stress? Current practice is to remove the plants from the wild when they are fully turgid. However, it seems that separating a near-mature saguaro from its root system at that time could cause greater shock than when the roots are less active. Furthermore, the rooting period and extent of stress are more or less predictable in Arizona but not in Nevada, coastal southern California, and elsewhere. Perhaps the Japanese horticulturists, who have imported and transplanted wild-collected saguaros and other cacti from the southwest, could provide educational models.

As transplanting techniques improve, perhaps successful methods will be passed along to dealers who lack the horticultural expertise to care for such delicate plants as saguaros and joshuas. Some nursery people show some concern about proper care and survival of their inventory. Newly-acquired plants are often neatly planted in sales beds where their prospects for survival are good if there is good soil preparation, exposure, and other attentiveness to the specific needs of newly-collected plants. Most of the nurseries I visited exhibited this care to some degree; after all, they did pay for the plants and allowing them to die from neglect was not good business. Most problems arise when landscape plants are sold prior to rerooting, when they are sold to landscapers and homeowners who were either insensitive to, or ignorant of, the well-being of succulents.

It would be wise to determine more detailed guidelines for removal, transport, and subsequent care of saguaros and other native succulents. The use of horticultural criteria should be applied to any attempt to rescue or salvage all endangered and protected plant species from habitat. Only with the application of effective salvage procedures and post-salvage maintenance methods can there be a healthy transition of a native succulent from natural habitat to a landscape or garden setting.

Perhaps some of the methods devised by Arizona seed collector Jim Hubbs and others for the successful transplanting of full-grown creosote bush (Larrea divaricata) would be useful in moving succulents. Using a technique commonly employed by southern California tree companies for digging, boxing, and moving oak tree specimens, Hubbs cuts the creosote's roots in two intervals several months

apart, thus allowing the plant to form a new and more restricted root ball. When the root cutting is complete and when it is clear that the plant is not in shock it is placed in a container and moved to a new location. It should be noted that specimen size is no obstacle to this technique; Hubbs' largest specimen moved in this manner was twelve feet tall (Hubbs, pers. comm.). Prior to the initiation of this tree-moving technique, creosote bushes could not be moved at all. Hubbs' results have been excellent.

Horticultural techniques such as Hubbs' could be applied to the removal of saguaros, joshua trees (and other large yuccas), and ocotillos. An extended period of careful root pruning could stimulate root formation around the base of the plant, which could be boxed or put in burlap and then moved. If this could be done, the stress and all-too-frequent plant losses experienced by landscapers and their clients would be greatly reduced. The likelihood of serious injury to saguaros could be limited to transport. Undoubtably, such special care requirements would have a definite impact on cactus diggers. For instance, diggers would raise prices because of extra time and labor spent preparing the saguaros for removal. And, such requirements might make it easier to catch up with violators, since a rustled saguaro probably would be rootless and easily detected — even after planting. In short, the requirement that certain procedures be met to facilitate the survival of a protected plant may reduce the number of cactus wranglers and their abuses of native succulents.

Recommendations:
State Cooperation

Southwestern states could raise additional revenue and further promote effective conservation by establishing a horticultural industry devoted to the growing and distribution of native plants for landscape use. While there are serious efforts underway to grow native mesophytes in the private sector, the challenge of growing native cacti and other succulents has not been met. Since many succulents do not grow rapidly, such an effort could take a considerable amount of time to be profitable (it can take up to twenty years for a saguaro or joshua to reach flowering size). One solution could be the formation of a state or federal program in conjunction with the native succulent industry to propagate native xerophytes from seed or cuttings. Increased permit fees could help subsidize such a program.

The survival of Arizona's unique plant heritage may depend upon the success of this or a similar concept, for the state's cactus trade statistics and permit fee revenues are directly linked to fluctuations in the housing industry; that is, as Arizona's population increases, saguaro and other landscape plant sales go up (Richards, pers. comm.).

Such a trial nursery program could be instituted in the southwest, where the

climate is suitable for growing succulents native to those regions. Native plants destined for export could be grown in the milder climate of California as well.

Nevada has developed the basis of this kind of program in the form of the State Division of Forestry's Tree Nursery located north of Las Vegas. This nursery has not, to my knowledge, added any succulents to its inventory of hardy trees and shrubs in southern Nevada, but it is a professional horticultural project established for the purpose of growing and distributing drought-tolerant plants to ranchers or individuals owning more than one acre of land. This project could be expanded with little difficulty by using a few acres, then planting a container crop of seed-grown joshua trees, saguaros, and ocotillos, grown to a landscape size.

Of course, it would take several years to develop the necessary horticultural techniques to profitably and effectively grow succulents to landscape size. At the end of this experimental period, a healthy and fully acclimatized landscape product would presumably be available for sale to wholesalers or retailers. At the same time, state or federal agencies could get out of the native plant business by turning over their data and expertise to private enterprise. This is very speculative, but it must be remembered that no southwestern state government has, to the best of my knowledge, a native succulent plant industry.

Recommendation:
Growing From Seed

Commercial wholesale seed growers occasionally attempt to produce native succulents from seed. The growers' motive does not appear to be the conservation of native succulents, but their work, if it results in healthy plants, would contribute dramatically to the conservation of southwest desert natives. In such nurseries today, one finds seedling beds of Ferocactus wislizeni and F. covillei and other native cacti, which may eventually reach landscape size. While seedling saguaros commonly end up in small pots destined for supermarkets and the souvenir trade, one southern California nurseryman grew them to larger size and was amazed to see that his best customers were from Arizona! When I observed the plants growing in an open field in San Diego County I was impressed that they responded so well to horticultural techniques. Their growth rates and appearance compared very well to the usual stock of cacti grown in this manner.

The survival of other landscape-sized succulents may depend in part on the commercial availability of propagated specimens. Many hedgehog cacti (Echinocereus spp.) are grown to specimen size by seed growers, but again these rarely find their way into the desert landscape trade. However, most are grown under greenhouse conditions, or in non-desert climate, and probably would not survive more than a couple of weeks of desert heat. One Phoenix grower started a crop of seedling boojum trees (Fouquieria columnaris) a few years ago, but unfortunately, they are being sold as container plants. They would probably perform nicely as a field

crop. The boojum tree (Fouquieriaceae), a CITES Appendix II species, is a very useful landscape plant. Very few are currently available. I did, however, see landscape specimens for sale in Phoenix, one of which was about ten feet tall and priced at $9,500.

Nurserymen may occasionally grow yuccas from seed, but usually on an experimental basis. Under professional care, seed-grown joshuas could become a commercial crop, an accomplishment that would certainly increase their garden survival rates.

Recommendation:
Improve Educational Opportunities

There is a great need to improve educational opportunities for landscape professionals and their clients. In Las Vegas, for example, the Cooperative Extension Service, which is most active in dispensing horticultural knowledge to the general public, would be useful in emphasizing drought-tolerant landscape design and sound maintenance procedures for native succulents. Such instruction is routine with general nursery stock but one hears little about cacti and other succulents. In addition, there should be greater publicity about the value of seed-grown plants and their benefits to conservation of those remaining in the wild.

The nurseryman, the landscape contractor, and the designer associations are all involved with local cooperative extension services throughout the southwest and could be recruited to formulate educational and training programs. They could also develop publicity and recommend legitimate sources of suitable landscape material to professionals and the general public.

I have suggested here that effective conservation of endangered, threatened, and depleted species requires a horticultural approach. As I have shown, currently acceptable salvage practices may backfire for species transplanted both within and outside their natural range. If sound horticultural concepts can have a positive effect upon the survival of succulents replanted within and beyond their ranges, perhaps such concepts should be incorporated into existing bodies of law. Such an effort, if made now, could prevent any further unneccessary depletion of native plant resources.

Reference

Steenbergh, W.F. and Lowe, C.H. 1977. Ecology of the Saguaro: II. National Park Service. U.S. Government Printing Office, Washington, D.C., 242 pp.

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Cactaceae	
subgenus Cylindropuntia	
Opuntia acanthocarpa	buckthorn cholla
Opuntia arbuscula	pencil cholla
Opuntia bigelovii	teddy-bear cholla
Opuntia echinocarpa var. *echinocarpa*	silver cholla
Opuntia imbricata var. *imbricata*	tree cholla
Opuntia kleiniae	Klein's cholla
Opuntia leptocaulis	Christmas cactus
Opuntia ramosissima	diamond cholla
Opuntia spinosior	cane cholla
Opuntia versicolor	staghorn cholla
Opuntia whipplei var. *whipplei*	Whipple's cholla
Opuntia whipplei var. *multigeniculata*	Clokey's cholla
subgenus Platyopuntia	

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Opuntia basilaris var. *basilaris*	beaver-tail cactus
Opuntia erinacea var. *erinacea*	
Opuntia erinacea var. *ursina*	grizzly bear cactus
Opuntia lindheimeri var. *lindheimeri*	
Opuntia lindheimeri var. *linguiformis*	cow's tongue cactus
Opuntia phaeacantha var. *discata*	
Opuntia phaeacantha var. *mojavensis*	Mojave prickly pear
Opuntia phaeacantha var. *phaeacantha*	
Opuntia polyacantha var. *polyacantha*	plains prickly pear
Opuntia violacea var. *gosseliniana*	
Opuntia violacea var. *santa-rita*	purple pancake cactus

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Opuntia violacea var. macrocentra	black-spined prickly pear
Opuntia violacea var. violacea	purple prickly pear
Opuntia vulgaris	common prickly pear
Cereoid cacti	
Carnegiea gigantea	saguaro
Echinocereus engelmannii var. acicularis	
Echinocereus engelmannii var. stamineus	straw cactus
Echinocereus enneacanthus var. stramineus	straw cactus
Echinocereus pectinatus var. pectinatus	
Echinocereus pectinatus var. rigidissimus	Arizona rainbow cactus
Echinocereus pentalophus	alichoche
Echinocereus triglochidiatus var. melanacanthus	black-spined hedgehog cactus
Echinocereus triglochidiatus var. mojavensis	Mojave hedgehog cactus

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Echinocereus triglochidatus var. *triglochidiatus*	red-flowered hedgehog cactus
globular cacti	
Astrophytum asterias	Texas sand dollar cactus
Echinocactus horizonthalonius	eagle claw cactus
Echinocactus polycephalus	cottontop cactus
Ferocactus acanthodes var. *acanthodes*	compass barrel cactus
Ferocactus acanthodes var. *lecontei*	Leconte's barrel cactus
Ferocactus covillei	Coville's barrel cactus
Ferocactus hamatacanthus var. *hamatacanthus*	
Ferocactus hamatacanthus var. *setispinus*	
Ferocactus wislizenii	fishhook barrel cactus
Homocephala texensis	horse crippler cactus
tubercled cacti	
Ariocarpus fissuratus	living rock cactus

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Coryphantha vivipara var. *arizonica*	
Coryphantha vivipara var. *deserti*	
Coryphantha vivipara var. *rosea*	
Mammillaria heyderi var. *macdougallii*	
Mammillaria heyderi var. *meiacantha*	
Mammillaria microcarpa	
Neolloydia erectocentra	
Neolloydia johnsonii	
Agavaceae	
Agave deserti var. *deserti*	
Agave lecheguilla	lecheguilla
Agave parryi var. *huachucensis*	
Agave parryi var. *neomexicana*	

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Agave parryi var. *parryi*	
Agave scabra	
Agave shawii	
Dasylirion leiophyllum	sotol
Dasylirion wheeleri	sotol
Nolina bigelovii	bear grass
Nolina microcarpa	
Nolina palmeri	
Nolina parryi	
Yucca aloifolia	
Yucca baccata	bannana yucca
Yucca brevifolia	joshua tree
Yucca brevifolia var. *jaegeriana*	dwarf joshua tree
Yucca carnerosana	
Yucca elata	
Yucca glauca	

Appendix

Some Native Cacti and Other Succulents Commonly Used in Southwest Landscaping

Scientific name	Common name
Yucca recurvifolia	
Yucca rostrata	
Yucca schidigera	
Yucca schottii	
Yucca tenuistyla	soap yucca
Yucca thompsoniana	
Yucca whipplei	lord's candle
Fouquieriaceae	
Fouquieria splendens	ocotillo

Cactus and Succulent Conservation in Action: The Politics of Plant Conservation

F. T. Campbell*

Introduction

Serious efforts to conserve succulents are now a little over a decade old. Although succulent conservation programs continue to suffer many weaknesses, they nevertheless have progressed further than similar efforts for other plant groups. This chapter discusses how and why programs to conserve succulents were adopted, the progress made in implementing those programs, and their current weaknesses. It also addresses ways to improve the programs. In short, I examine the politics of plant conservation.

From the beginning, large gaps in our knowledge about which plant species were most endangered and the factors threatening them have hindered conservation efforts. The historically low level of public support for plant conservation, especially as compared to the vocal cries for protection of certain mammals and birds, has contributed to this problem. We, as plant conservationists, can now see progress on this score, thanks in part to the information and public awareness created by the existing programs.

CITES

The principal international plant conservation agreement is the Convention on International Trade in Endangered Species of Wild Fauna and Flora, or CITES. It is the only global treaty that includes plants explicitly; its adoption stimulated efforts by the United States and many other nations to conserve plant species.

The idea for an international treaty to control wildlife exploitation first surfaced at a meeting of the wildlife department heads from the newly independent African states held at Arusha, Tanganyika, in 1961. The wildlife directors found that they were unable to curb poaching as long as the demand for live wildlife and wildlife products in Europe and the U.S. remained strong. They proposed a treaty that would obligate the consuming countries to cooperate in reducing demand for poached wildlife. Although the focus of the meeting was on rhinoceros, leopard, and other large fauna, from the beginning it was agreed that plants should be included under the proposed treaty (Talbot, pers. comm.).

In 1963, the world's premier international conservation organization, International Union for Conservation of Nature and Natural Resources (IUCN), took up the task of drafting the treaty. This process took nearly ten years and at least seven drafts.

* Dr. Campbell is the Director of the Plant Conservation Program at the Natural Resources Defense Council, 1350 New York Avenue, N.W., Washington, D.C. 20005.

In 1970, the U.S. Government became an active participant in treaty drafting partly as a result of Congressional passage of the 1969 Endangered Species Conservation Act, which instructed the government to seek an inter-ministerial meeting to negotiate a conservation convention. The presence of Dr. Lee Talbot, leader of the Arusha meeting, on the staff of the Council on Environmental Quality also spurred U.S. action.

The U.S. campaign included several projects to clear an international path for the treaty and provide strong U.S. leadership. First, the U.S. sought to strengthen the draft, which would be the basis for the final treaty. This was thought necessary because IUCN's draft had come to reflect the views of the European countries, who are primarily wildlife importers (Talbot and Bohlen, pers. comm.). The committee responsible for preparing the U.S. position included the Departments of Interior; State; Agriculture; Health, Education, and Welfare; the Bureau of the Customs; Council on Environmental Quality; and Smithsonian Institution. Assistant Secretary of the Interior for Fish, Wildlife and Parks, Nathaniel Reed, had to overcome considerable oppposition among policy makers in the Nixon White House in order to ensure the strong U.S. position (Reed, in litt.).

Perceiving that a U.S. draft would not be accepted by other countries or the IUCN, the U.S. government secretly assisted Kenya in finalizing a strong draft that could be presented as the will of the "producer" countries (Talbot and Bohlen, pers. comm.). This draft became public in the winter of 1971-1972.

At this time, Talbot and Reed jointly headed a United Nations meeting on conservation issues in preparation for the Conference on the Human Environment scheduled for June 1972. Their leadership resulted in the Conference endorsing a treaty to regulate trade in endangered species, specifically including flora as well as fauna (Talbot, pers. comm.). Talbot also travelled to the United Kingdom, Sweden, and other European countries to discuss their hesitancy about the treaty's purpose and manner of implementation (Talbot, pers. comm.).

At home, the U.S. began to write its own draft.

Originally, the U.S. planned to hold the international conference to negotiate the treaty in April 1972. This was postponed, however, with the official explanation that planners needed more time to incorporate ideas from the Kenyan draft and from conservation organizations with whom the committee was consulting (Anon., 1972a). In reality, the U.S. probably believed conditions were not yet right to obtain a strong treaty based on the Kenyan draft (Bohlen, pers. comm).

The U.S. invited all other nations to attend a conference in 1973 to negotiate and sign a final text. In preparation for the conference, efforts to reconcile the three drafts (developed by IUCN, the U.S., and Kenya) and to draw up lists of protected species accelerated. Compilation of species lists was complicated by the lack of reliable data on trade volumes, biological status (for animal as well as plant species), and by the preliminary nature of the text.

The treatment of plants in the text remained one of the unresolved questions. Early IUCN drafts included plants on a generally equal basis with animals. Then, in 1971, IUCN recommended exemption of both captive-bred fauna and "cultivated" plants from treaty controls (Fust, in litt.). The U.S. government was uncertain of its position on plants. By the end of 1971, some U.S. negotiators accepted the exclusion of cultivated plants while opposing exclusion of captive-bred fauna. Others preferred inclusion of both captive-bred fauna and cultivated plants in conjunction with easier permit requirements for such specimens. Proponents of this view argued that any exemption would make enforcement more difficult (Anon., 1972b).

By April 1972, the U.S. draft included plants — whether wild or propagated — but excluded seeds (Anon., 1972a). Discussion continued, however, and the subsequent draft position paper addressed the inclusion of seeds (at least of Appendix I species) but excluded "cultivated" plants (Heymann, 1972).

By the time the countries gathered in Washington in mid-February 1973, several lists of proposals were circulating. Reflecting the paucity of information, the only plant species proposed for Appendix I (the most protective) were Welwitschia bainesii, a few Encephalartos species, and a few orchids. Proposals for Appendix II showed considerably more variation, probably reflecting both differing national approaches to conservation and the continuing discussions over the purposes of this appendix. Some countries, including the U.S., favored listing of individual species which might be threatened by trade. The U.S. suggested that the Conference list certain species of Cactaceae, succulent Euphorbia, bromeliads, dipterocarps, and several genera of orchids. Others suggested that genera or even families should be listed because of the difficulty of distinguishing particular species. These countries proposed all Cactaceae except the genus Opuntia (and some non-succulent species), all Aloe species, and the succulent Crassulaceae as well as additional orchids, bromeliads, and dipterocarps.

A Committee II (Flora) assumed responsibility for sorting out treatment of plants under the treaty and determining which species to place in which appendix. The Committee members included William Hartley of Australia, George Argus of Canada, Grenville Lucas of United Kingdom, Ruggero Tomaselli of Italy, Thomas Elias and F. Raymond Fosberg of the U.S., Douglas Hey of South Africa, Gunnar Seidenfaden of Denmark, a representative of West Germany, and others. There was disagreement over the Committee's task. Some thought that it was merely to draw up lists of species that should be protected, while the botanists on the committee clearly believed that they should also seek to influence the text of the treaty to ensure that it conformed to their views on plant conservation. There were then — and in many cases still are — considerable differences between botanists and zoologists on appropriate conservation methods, and development of CITES had been dominated by zoologists.

Committee II set about its charge as its members saw it. Members found their work trying. They scrambled to attend the several subcommittees that were drafting various parts of the treaty to ensure that the text reflected plant conservation issues and methods. They also had to evaluate species proposals, received from 17 countries. In many instances these lists did not include substantiating information and there were no botanists available to represent the countries making proposals. Therefore, the members of Committee II worked into the night in the library of the Smithsonian Institution, trying to find information on proposed plants' distribution and biological status. On the basis of this work, the Flora Committee rejected many proposals.

Committee II then prepared a report to the Conference, written by Dr. F. Raymond Fosberg, which discussed in detail certain "philosophical" issues, particularly advocating exclusion of propagated plants and herbarium specimens (Fosberg, pers. comm.). This recommendation upset some leaders of the negotiations, who did not want plants treated differently from animals in substantive ways and feared that the exclusion of cultivated plants would become a precedent to exclude captive-bred animals (Baysinger, pers. comm.). They may also have recognized that exclusion of propagated plants would greatly complicate enforcement. The negotiators prevailed upon the Committee to change its report and to delete references to these issues. Angry, Dr. Fosberg left the proceedings. The Committee's preferences were not ignored, however. In the final document, propagated plants were covered by CITES, under more flexible permit requirements than wild plants (this had been the recommendation of someone in the Department of the Interior as early as December 1971). Non-commercial herbarium exchanges between registered institutions are exempted, along with museum exchanges, under a system established by Article VII.

The revised Committee II report proposed for inclusion in Appendix I only one succulent, Welwitschia bainesii. For Appendix II, it recommended all cacti from the Americas, plus Rhipsalis species, all succulent Euphorbia species, and all Pachypodium species. A large number of non-succulent plants were also proposed, including the genus Encephalartos in Appendix I and the Orchidaceae in Appendix II. The report did not propose several groups considered earlier. It dropped these due to uncertainty about their biological status or objections by governments of the countries in which they grow. These included Aloe species, mesembs, and Crassulaceae. Other groups were added, including Pachypodium and Anacampseros, apparently on the basis of ideas occuring during the Committee's deliberations. A number of groups, such as Haworthia, not mentioned in the report simply had not occurred to anyone (Lucas, pers. comm.). During the discussion of Committee II's proposals, the plenum restored Aloe species to Appendix II.

The Committee's decision to list higher taxa -- genera or sometimes families — came at the urging of the United Kingdom, which was very sensitive about the

difficulties customs officers faced in identifying particular species. The Committee also recognized that little was known about the species in trade and the level of threat; inclusion of higher taxa would enable gathering of data to answer these questions. This solution, of course, raised fears that CITES trade restrictions would impede legitimate trade in the vast majority of species in these taxa that were not endangered. Dr. Seidenfaden of the Danish delegation voiced this fear most strongly. The issue remains one of the most difficult today, with most countries continuing to voice their traditional positions. Despite remaining questions, the Parties accepted the recommendations of the Committee at the Washington meeting in 1973.

CITES came into effect in 1975 upon ratification by ten countries. As of June 1986, 92 countries had joined the treaty; the European Economic Community (EEC) was enforcing it uniformly, even for those countries that had not yet joined.

At the biennial conferences, the Parties have made several changes in the appendices that affected succulents. They added the Didiereaceae in 1977 to Appendix II, followed by the Ceropegia in 1979. In 1981 and 1983, the Parties differentiated among the levels of threat in some of the higher taxon listings. At those meetings, 35 cacti and one Pachypodium species were transferred to the more protective Appendix I. Also in 1983, three Agave, one Nolina, two Dudleya, three Fouquieria, and four Lewisia species were placed on Appendix I or II.

During these periodic meetings there has been a continuing problem of inadequate attention to and expertise on plant conservation among national delegations, non-governmental observers, and the CITES Secretariat itself. The appointment in 1983 of a special Plant Working Group to develop recommendations for adoption by the 1985 meeting created some progress in this regard. The Plant Working Group included representatives of the United States, United Kingdom, Australia, Canada, Denmark, and India; the European Community; IUCN's Threatened Plant Unit and Wildlife Trade Monitoring Unit (WTMU); World Wildlife Fund (WWF), Natural Resources Defense Council (NRDC), and the Center for Environmental Education (CEE).

At its first meeting in 1984, the Plant Working Group agreed that Appendix I listing of particular endangered species is appropriate, and that higher taxa must remain on Appendix II because of the lack of identification aids available to implementing agencies and the sketchy knowledge about which species are most endangered. The Group reached agreement on a broad range of recommendations intended to raise countries' attention to the plant trade and improve their enforcement of CITES. However, the Group was divided on whether to retain stringent documentation requirements for artificially-propagated specimens of

Appendix I species. Representatives of Denmark and the EEC urged greater flexibility to reduce paperwork and promote trade in propagated plants. The other members of the Group supported stringent permit requirements, arguing that the species concerned are extremely rare in the wild and trade controls are not yet adequate to prevent illicit trade in wild-collected specimens improperly labelled as "propagated." The Group's recommendations were adopted in somewhat altered form at the Fifth Meeting of the Conference of the Parties.

During the Fifth Meeting of the Conference of the Parties, resolution Doc. 5.24, "Improving Implementation of the Convention for Plants," was adopted without dissent. After reiterating the need to regulate trade in certain plants (a matter that should be self-evident, but which has been questioned by both Parties and some non-governmental organizations), the resolution recommended specific actions to encourage additional countries to join CITES, refine the list of plants in the appendices, and develop a standardized list of plant names. In addition, the resolution recommended that the CITES Parties prepare identification materials, allow trade in salvaged plant specimens, describe procedures for handling confiscated plant specimens, report on trade in plants, enforce CITES requirements, and educate the public about the plant trade.

A second resolution, Doc. 5.26, was hotly contested until the final days of the Fifth Meeting. As at the 1984 meeting of the Plant Working Group, the conflict divided countries such as Denmark and the Netherlands, which have large nursery industries and wished to minimize documentation requirements for propagated plants; and conservationists who feared that too great a reduction in documentation would allow continued voluminous trading in wild plants improperly labelled as propagated and would prove a bad precedent for future interpretation of the treaty for all taxa. NRDC led the opposition to a significant change in CITES practice, arguing that large numbers of wild bulb and tuber plants have been improperly documented as "artificially propagated" by Netherlands in the past, and that Denmark has never provided data to substantiate its claim that its country's nurseries propagate large numbers of Appendix I species. The group eventually worked out a compromise, which the Plenum adopted without further discussion.

The compromise is open to several interpretations. Its text does not condone the use of phytosanitary documents as CITES permits for trade in artificially-propagated Appendix I plants, as originally sought by Denmark and the Netherlands. Rather, it recommends inspection and licensing of propagators of CITES-listed plants, whatever the appendix in which they appear. It further states that such licensed propagators may be authorized to trade in any quantity of specified Appendix II or III propagated plants within a particular time frame. By remaining silent on the question of Appendix I plants, the resolution implicitly accepts the earlier resolution, Conf. 2.12, which states that such plants must be documented by a CITES export permit, not an artificial propagation certificate or one of the licenses suggested in the resolution. However, the European countries will probably continue to use phytosanitary certificates.

Another plant issue directly affecting cacti arose just before the Fifth CITES Conference of the Parties: F.R. Germany and other countries insisted, on the basis of current Convention wording, that CITES only covered cacti physically located in the Americas. The Plant Working Group developed a resolution to clarify that all cacti are protected -- regardless of their location -- in order to prevent laundering of plants smuggled out of the Americas to Europe and Japan. However, the CITES Secretariat raised procedural objections to adoption of the resolution at the Conference. The resolution was then submitted to the Parties in February 1986 as a proposal to amend the appendices and was unanimously approved in June 1986 by postal vote.

Endangered Species Act

Adoption of CITES stimulated the passage of national plant protection legislation in the United States. In fact, it is probable that the Endangered Species Act (ESA) of 1973 would not include plants at all had it not been for CITES. Although individuals in the Department of the Interior and Council on Environmental Quality advocated including plants under the Act, the staff of the Bureau of Sports Fisheries and Wildlife opposed this recommendation. More importantly, the Department of Agriculture did not want the responsibility of regulating imports and exports, and blocked Interior from formally proposing any action. Members of Congress, concerned about implementing CITES and encouraged behind the scenes by Lee Talbot and Earl Baysinger, forced inclusion of plants over official administration objections.

The Department of the Interior began consideration of legislation to strengthen the Endangered Species Act and implement the pending CITES treaty in 1971. Plants were included in a draft bill written by Baysinger in the first half of 1972 but were cut out of the bill before its introduction as a result of Agriculture's opposition (Baysinger and Bohlen, pers. comm.). Concerned about U.S. implementation of the pending treaty, Congress raised the issue of plant inclusion. In March 1972 a hearing was held on the bill (H.R. 13081) to strengthen the ESA before the House Subcommittee on Fisheries and Wildlife Conservation, chaired by John Dingell of Michigan. The Subcommittee's counsel, Frank Potter, noted that the draft treaty would regulate trade in plants and asked whether the Department of the Interior had given "any consideration" to including plants in the bill. Deputy Assistant Secretary for Fish and Wildlife and Parks, E. U. Curtis Bohlen, replied, "No, we did not, but this is an obvious need." Bohlen said regulation of plant imports and exports was under the jurisdiction of the Agriculture Department, although Baysinger suggested that Interior could do the job if Agriculture did not wish to and Potter urged Interior to look into the matter (Anon., 1972a). Nearly two months later, Interior sent a letter to the Secretary of Agriculture to ask that he designate someone to work with the Office of

Endangered Species to resolve this matter (Anon., 1972a). [In the meantime, the State Department pointed out that proposed legislation to implement the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere should include regulation of the plant trade (Anon., 1972a).]

Congress continued to press faster than the Administration was able or willing to move. In June, 1972 Senator William Spong of Virginia, Chairman of the Commerce Committee's Subcommittee on Environment, introduced a wildlife conservation bill containing plants. Senator Spong's bill, S. 3818, stated that its purpose was "to provide a program for the conservation, protection, restoration, or propagation of species and subspecies of fish and wildlife and flora that are threatened with extinction, or are likely within the foreseeable future to become threatened with extinction" (Anon., 1972c). Because of the focus on implementing CITES, the emphasis for plants was on the threat posed by collecting and trade. S. 3818 prohibited import, export, transport, and "taking" of listed plants; the latter was broadly defined as "to collect, sever, remove, or otherwise damage in any manner, or to attempt" the same (Anon., 1972c). However, the bill provided for the Secretary of Interior to use all programs under his jurisdiction only to conserve listed species of fish and wildlife, not plants (Anon., 1972c).

Hearings were held on S.3818 and two other Senate bills in August 1972; the inclusion of plants was one of several contested issues. Conservation organizations supported the idea, but the government objected because it lacked expertise on flora (Talbot and Baysinger, pers. comms.). Reed asked postponement of any legislation to protect flora while the subject was studied and indicated that CITES would address the issue. Senator Spong nevertheless asked Reed whether Interior had authority and personnel to manage endangered plants. Although Interior had no botanists on staff, Reed answered that it did, in cooperation with the Bureau of the Customs and Department of Agriculture (obviously, all were thinking of trade regulation primarily). Reed once again questioned whether it was wise to "encumber this very good piece of legislation on endangered animals, S.3199 (the Administration bill), with that" (Anon., 1972c). The Department obviously feared that controversy over provisions to protect plants might sink the entire bill.

Senator Spong persevered. He asked the National Oceanic and Atmospheric Administration (NOAA), which would receive jurisdiction over marine wildlife, whether it or Agriculture should be responsible for marine plant species; NOAA replied that it should, with scientific help from the Smithsonian Institution (Anon., 1972c). The Agriculture Department, represented by the Associate Administrator of the Animal and Plant Health Inspection Service (APHIS) and a botanist from the Agricultural Research Service (ARS), expressed concern about endangered plants (especially crop relatives) and pointed out the need for habitat protection. In keeping with the Administration position, Agriculture also called for further study. The witnesses noted the recent creation of a committee of

experts from the Forest Service, APHIS, and ARS as well as Interior and Commerce to work on a solution (Anon., 1972c). In response to a question from Senator Spong, Agriculture said that it could enforce plant trade controls contained in S. 3818 (Anon., 1972c).

Several conservation organizations supported inclusion of plants in the legislation. The Nature Conservancy, represented by Dr. F. Raymond Fosberg, was most emphatic about the need. As illustration, Fosberg cited several articles about the dire straits of Hawaiian flora. Representatives of the National Parks and Conservation Association, Sierra Club, and Defenders of Wildlife endorsed inclusion of plants. National Audubon Society, by letter in response to a direct question, also endorsed their inclusion, but not if it delayed passage of the bill. The Society for Animal Protective Legislation similarly qualified its support, saying it opposed any decreased enforcement for vertebrate animals.

The Senate Committee reported out a bill, but the full Senate never considered it due to opposition by Senator Ted Stevens of Alaska to the way the bill dealt with Eskimos' hunting of whales.

In early 1973, Congress again took up proposed endangered species legislation, this time with the added pressure of the conclusion of the successful CITES Conference. Again, the Administration's bill excluded plants. However, Congressman John Dingell of Michigan, a member of the U.S. delegation to CITES, included plants in his bill, H.R. 37. Congressman Dingell opened a hearing on the bills on March 26 by noting the inadequate protection for plants in existing laws and in most of the proposed bills. He also remarked on the Administration's continuing silence on the issue. Although his and several identical bills instructed the Smithsonian Institution to study the problem, Dingell said, "I would hope that we can do better" (Anon., 1973a). One bill, introduced by Congressman Thomson of Wisconsin (H.R. 2735), did more. In addition to mandating the Smithsonian study, it also prohibited "taking" of listed plant species as defined in Senator Spong's bill the previous year (Anon., 1973a).

Once again, the Administration was divided on the treatment of plants and therefore asked for delay on the grounds that too little was known about the status of endangered plants, how to address legal aspects, and the division of authority of the government agencies. Nathaniel Reed, speaking for Interior, said that recognition by CITES of the importance of preserving flora made a similiar finding by Congress unnecessary. He added that Interior, Commerce, Agriculture and the Smithsonian Institution were cooperating to determine "what, if any, additional authorities are needed to preserve endangered flora pursuant to the Convention." Although this effort had been under way for ten months, Reed said it was premature to provide specific recommendations (Anon., 1973a). The government even opposed language providing for a study by the Smithsonian Institution on grounds that the Smithsonian had adequate existing authority to inventory rare plants (Anon., 1973a). Behind this stance was the Institution's insistence that Congress could

not instruct it to do anything (Bohlen, pers. comm.).

During the hearing, subcommittee counsel Potter asked several Administration witnesses what progress had been made on the issue of plant inclusion, and noted that Congress needed to adopt legislation to implement CITES, which had been signed but had not yet come into effect (Anon., 1973a).

In its search for expert advice on how it should treat plants, the Committee called in Howard E. Irwin, president of the New York Botanical Garden. Unfortunately, Irwin had not seen the proposed bills in advance, (Anon., 1973a) and lacked experience in the legislative arena. Dr. Irwin's testimony emphasized the need for greater habitat protection compared to trade regulation (Anon., 1973a). Later, in a letter to the Committee, Dr. Irwin answered questions on the probable number of endangered floral species in the U.S. (1,000 flowering plants, unknown number of others); pled for habitat protection; said seed banks were of dubious value; and suggested that the federal role should be regulation of international trade and purchase of habitat, while the states should prohibit collection and trade and also purchase habitat. More generally, Dr. Irwin supported inclusion of plants on an equal basis with fauna and led The American Association of Botanical Gardens and Arboreta to adopt a resolution in April 1973 strongly stating its willingness to provide further help (Anon., 1973a).

The Smithsonian Institution, by letter, supported the Administration's bill (which excluded flora), and affirmed that the Smithsonian already had adequate authority to study rare plants. Its concluding sentence expressed the hope that the Congress would increase protection for endangered species (Anon., 1973a). Smithsonian botanists were, in actuality, eager to carry out the study (Bohlen, pers. comm.).

Among the conservation organizations, National Parks and Conservation Association, Friends of the Earth, Defenders of Wildlife, and Sierra Club supported protection for plant species — although several cited the importance of plants to wildlife as a reason (Anon., 1973a). The National Wildlife Federation said it could find "little reason" for inclusion of flora in H.R. 37, the Dingell bill (Anon., 1973a). The American Forestry Association supported the proposed Smithsonian Institution study (Anon., 1973a).

Following the hearings, the Committee concluded that plant protection was "urgent" but that many questioned application to plants of measures developed for wildlife. The question of whether the federal or state governments should regulate domestic trade was especially troubling to the Committee. Advocates of plant protection feared that prohibition of "taking" would stir opposition if it was seen as a form of federal land-use control, especially since landowners are considered to own plants (but not wildlife) (Bohlen, pers. comm.). Unable to resolve all of these issues, the Committee adopted a bill that provided for habitat acquisition for CITES-listed plant species, regulation of importation and exportation of

CITES-listed plant species, and assistance to foreign governments working to conserve plants. Other issues, especially regulation of interstate trade, were referred to the Smithsonian Institution for study. Regulation of imports and exports was assigned to the Department of Agriculture, which was believed to have adequate authority and enforcement mechanisms. (Anon., 1973b).

In June the Senate held brief hearings on two bills, the Administration's and one introduced by Harrison Williams of New Jersey. The latter, S. 1983, was based on Senator Spong's bill of the year before. It prohibited import, export, taking, transport of plant species listed as endangered or threatened, and provided for land acquisition and ccoperation with the states and foreign governments to conserve listed plant species.

During the hearing, Senator Ted Stevens persistently questioned whether inclusion of plants would require referral to the Agriculture Committee and would interfere with state programs. Stevens suggested that protection of endangered flora should be part of a land-use planning program then under consideration (Anon., 1973c).

Although representatives of four environmental organizations supported inclusion of plants (Anon., 1973c), and Senator Williams, in a statement in support his bill, said the paucity of information made beginning a program all the more imperative (Anon., 1973c), the Senate Committee removed all references to flora except the call for a study by the Smithsonian Institution (Anon., 1973d). During floor debate, at the request of the Smithsonian, the bill was amended to transfer responsibility for the study to the Department of Agriculture (Anon., 1973d).

When the separate House and Senate bills were reconciled by a conference committee, however, a miracle occurred: endangered plants suddenly received almost the same protection as endangered animals. The Endangered Species Act finally adopted in December 1973 provided for the listing of endangered or threatened species or subspecies of plants (although not of geographically separate populations, as may be done for vertebrate animals); and prohibited interstate commerce as well as import and export of endangered plants. These changes resulted from informal consultations between Subcommittee counsel Potter and Interior Department officials Bohlen and Baysinger (Bohlen, pers. comm.). The law did not prohibit the "taking" of listed plant species to avoid fears about exacerbating the dispute over federal versus state jurisdiction and becoming entangled in issues of landowners' property rights.

The Act assigned the Fish and Wildlife Service authority to enforce interstate trade regulations and the Agriculture Department jurisdiction over exports and imports. As we have seen, Agriculture was reluctant to protect plants without further study and considered trade regulation counter-productive in conserving crop relatives (the group it was exclusively interested in).

The mandated Smithsonian report on flora, submitted in January 1975, consisted primarily of a list of species believed to be threatened. It became the foundation of the Fish and Wildlife Service's list of "candidates" for listing, published in June 1976. Among the approximately 1,700 species and subspecies considered potentially eligible for endangered status were 34 cacti, 4 Agave species, 3 Nolina species, 14 Crassulaceae, 1 Lewisia species, 2 Portulaca species, and numerous Euphorbia species (apparently none of which were succulent). The Fish and Wildlife Service then hired a botanist and adopted regulations incorporating plants into the existing program. The first succulents formally protected under the Act were a Dudleya listed in 1978 and 21 cacti listed in November 1979. Since then, an Agave and two cacti have been added.

The Fish and Wildlife Service continues to refine the list of "candidates" using improved information. As of 1985, approximately 2,500 species and subspecies of plants were considered to require protection as endangered or threatened species, among them 63 cacti and 29 Dudleya and Sedum (Anon., 1983a).

In 1982, during one of the periodic Congressional reauthorizations of the ESA, NRDC led a coalition that successfully avocated amending the ESA to prohibit collection of endangered plants from federal lands. The Fish and Wildlife Service issued implementing regulations for the new provision in September 1985. In 1985, an attempt to further strengthen the Act by adding the requirement that written permission of the landowner must be obtained before endangered species may be collected from non-federal lands, failed due to the opposition of Representative Don Young of Alaska. Other representatives and senators wished to avoid "controversial" amendments during this reauthorization.

Lacey Act

In 1981, Congress amended the Lacey Act to improve control over domestic trade and collection of rare plants. The statute, first enacted in 1900, makes it a federal crime to transport across state lines, to import, or to export, wildlife taken contrary to the law of the state or country of origin. With the help of TRAFFIC(U.S.A.), the state of Arizona, and several wildlife organizations, NRDC persuaded Congress to amend the Lacey Act to include native American plants. Thus, it is now a federal crime to transport across state lines or to export plant specimens collected contrary to a state endangered species law or species that are on the CITES appendices and protected by other state legislation. Congress had in mind statutes such as the Arizona and California laws regulating the collecting of desert plants. Other states with laws regulating the collecting of cacti and succulents are Nevada, New Mexico, and Texas.

Recent Developments

During the 1970s, public awareness of plant collecting as a conservation problem grew. Collecting itself probably increased; certainly press reports of

cactus "rustling" in Arizona and California and voluminous collecting in Texas became more common. This pressure led to strengthening of the Arizona law protecting desert plants and to the adoption of a similar law in California. Among those who expressed concern was Gary Lyons, conservation chairman of the Cactus and Succulent Society of America (see his chapter, this volume). His editorials and articles in the society's journal criticized some of the proposed trade regulations in CITES and the ESA as impractical (Lyons, 1979).

In the late 1970's, I also became active on the issue of trade controls. My involvement arose from the U.S. Department of Agriculture's failure to enforce CITES controls with regard to imports and exports of cacti and other plants officially protected by the treaty. The Department of Agriculture's inaction had been brought to public attention by Roger McManus, the botanist with the U.S. Endangered Species Scientific Authority, who was responsible for approving permits for export of these plants.

As I tried to pressure Agriculture to implement CITES, I became increasingly aware of the paradox of trying to control international trade in these species when the larger domestic trade and collecting itself remained legal.

Enforcement

Adoption of conservation legislation is just the beginning, of course. Equally important is its effective implementation. Here, several problems remain.

The fundamental problem is a lack of enforcement for CITES, Endangered Species Act, and Lacey Act trade controls. There are several explanations for this. One is the low level of general public concern about plants and consequent lack of pressure to conserve them. A second is the assignment of responsibility to agricultural agencies that lack an institutional commitment to conservation and are not accustomed to acting as policemen. A third is a lack of adequate staff and funds within these agencies.

The budget issue has been another factor in plant-trade enforcement. CITES and ESA came into force in the mid-1970s, just when intense pressure began building to cut the federal budget. Conservation organizations were slow to realize the need for increased budgets, so they did not work to counter the trend. When they did begin lobbying for higher appropriations in later years, they focused on the trade in fauna. This resulted in long delays in instituting plant enforcement programs.

A primary example of the enforcement problem can be seen in the Department of Agriculture, which is charged with inspecting plant imports and exports and ensuring that they comply with the CITES and Endangered Species Act requirements.

Agriculture delayed 11 years after receiving this responsibility before issuing final regulations to implement these programs. Furthermore, it procrastinated on adoption of a policy governing the seizure of illegal exports. Finally, with no staff assigned to investigate and prosecute violations and with evidence in departmental files and from informers indicating violations of CITES and ESA, Agriculture sought FWS enforcement help in 1984. In the meantime, the Department attempted only one enforcement case, in 1978 against the late cycad dealer Burt Greenberg, which it eventually had to drop. Under the 1984 Agriculture-FWS contract, the first successful CITES plant case occurred. In August 1985, Joseph Anthony, a Texas cactus dealer, pled guilty to exporting 25 cacti of Mexican origin without the required CITES permits. Anthony received a $4,000 fine and probation.

A second case was in progress at the time of writing. In March 1986, FWS served search warrants on two California cactus dealers, Wendell Minnich and Edward Gay, and private collector Steven F. Sobel. FWS agents seized 179 Appendix I Mexican cacti allegedly imported without permits and volumes of substantiating records and photographs. The FWS indicted nine people in this case in June 1986.

The FWS, responsible for policing interstate trade in plants protected by the Endangered Species Act and Lacey Act, did not actively investigate cases until 1983. It has been difficult for me to assess the Service's enforcement effort because it is so decentralized that it has no easily accessible summary data to describe its work. As of March 1986, no cases had yet been brought under the ESA. The first Lacey Act case was brought in 1985. Ralph and Dorothy Millard, a couple in Michigan, pled guilty to selling about 2,000 lady slipper orchids that had been collected in violation of Michigan law. Evidence developed in the case showed that in some years, the Millards had sold 70,000 to 100,000 plants. The couple received a fine of $1,000 and a suspended jail term, and were put on probation. A second Lacey Act case, involving ginseng, was announced in June 1986.

The poor enforcement effort is intimately linked to other problems plaguing CITES, the Endangered Species Act, and Lacey Act. Indeed, the relationship is circular — the lack of interest in enforcement translates into failure to address these other weaknesses while the resulting absence of reliable trade data, identification aids, and a sensible policy toward propagated plants contributes to the belief that the problem is not serious and greater enforcement efforts are not necessary.

The lack of reliable data on the volume of trade in individual plant species is one of the most important contributing problems. CITES was supposed to provide such information through annual reports published by each participating country, and certainly CITES data are the best we have at the moment. But this information remains patchy in coverage, and much of it is probably incorrect. A majority of CITES countries either have issued no reports at all, or do not include data on the plant trade. As of 1980, only 14 of the then 61 parties reported on

plant trade (Anon., 1983b). Even when the plant trade was reported, the data were often incomplete. In that same year, only about one percent of the export/import transactions were reported at the same volume by both parties involved (Anon., 1983c).

Other deficiencies mar those reports that do appear. They are often quite tardy, so that we must base our actions on outdated information. The reports rarely differentiate between wild and propagated plants. When propagated origin is indicated, it may be incorrect. The CITES parties have adopted a stringent definition of "propagation" that requires reliable production of a second generation without reliance on wild stock. Rooting of collected cuttings or division of rhizomes or other tubers does not fit this definition. Nevertheless, many countries appear to accept such plants as "propagated." Other parties apparently issue "propagation" certificates without hesitation for clearly wild-collected plants. Species names, when reported, are sometimes incorrect. Finally, the trade is often reported by genus or even family, rendering it useless for evaluating the trade's effect on individual species, the focus of greatest concern.

We must also be aware that a significant proportion of the trade probably did not have CITES permits due to the lax enforcement and thus did not show up in the reports in any form.

Finally, CITES reports cannot provide information about the domestic trade (which in the U.S. is certainly larger than the international trade) or commerce in species not in the appendices (but possibly more threatened by trade than some species in the treaty).

Other sources of data could be used to supplement the CITES reports, but it is time-consuming to obtain the desired information and little effort has been made to do so. Among these sources are the records of plant health certificates maintained by virtually all countries. These documents usually indicate at least the general type of plant in trade and the number; if officials wished to use them to evaluate the trade, they could insist that at least the genus name be provided.

The paucity of reliable trade data reflects the low enforcement effort. If responsible agencies vigorously implemented CITES, we would have more complete figures, a better match between countries' reports, a higher proportion of species names reported, and more confidence that the names accurately represented the plants in trade. On the other hand, the poor quality of the data undermines efforts to improve enforcement because it is hard to "prove" that violations are occurring and that they are threatening the survival of plant species.

Finally, of course, valuable as these trade data would be, they would not substitute for information on the status of the species in the wild and their reproductive rates.

A second problem springing from and contributing to poor enforcement is the difficulty in identifying individual species. At present, many Agriculture Department officials probably cannot distinguish a cactus or Pachypodium from a Euphorbia, much less recognize one of the three Ariocarpus species on Appendix I. Rather than developing a CITES-oriented identification manual, Agriculture compiled a list of standard reference works, which port staff have purchased when funds became available, and also hired several inspectors with botanical training to perform routine identifications. One employee put together an extensive but preliminary identification manual on his own initiative and shared it with his colleagues. However, border inspectors need descriptions and drawings of the plant specimens as they appear when traded — without such commonly used identification characteristics as flowers and leaves.

The U.S. accepts the principle that the government that nominates a species for protection under the treaty should prepare identification materials. However, neither Agriculture nor Fish and Wildlife Service has funded work on plant identification manuals, even for the 40 cactus species transferred to Appendix I at U.S. suggestion. The CITES parties have formed a cooperative ID Manual Committee, but so far it has produced animal species identification sheets. The Plant Working Group plans to address this issue again at its June 1986 meeting.

The Plant Working Group, made up of several CITES party countries and cooperating non-governmental organizations, devoted considerable time to the problem of identification materials at its initial meeting in February 1984. A sub-group is to approach the ID Manual Committee to work out a method of working together on producing the first species sheets. We will have to seek much of the funding and staff time from non-governmental organizations. We hope that cactus and succulent societies and dealers will follow the lead of the fur, leather, and pet dealers by providing both funds and technical assistance in this work.

The absence of identification materials hinders CITES enforcement by preventing inspectors from ensuring that the plants in shipments are those for which the permits were issued. It is crucial that this handicap be overcome because unscrupulous dealers have reportedly mislabeled their imports or exports in order to trade in protected species.

No formal program provides identification aids for domestic trade. When the Fish and Wildlife Service investigates crimes involving wildlife, it has access to a sophisticated forensic laboratory and experts in identifying everything from leather watchbands to bird feathers. It is imperative that it develop comparable resources for plants under its jurisdiction. At present, the Fish and Wildlife Service relies on outside experts to carry out occasional plant identification work.

A major factor complicating enforcement of all three statutes is the fact that a large proportion of the trade is in propagated plants. This segment of the

trade affects wild populations only indirectly, by confusing enforcement priorities and perhaps by stimulating demand for wild plants of the same species. Propagators resent the trade restrictions, especially when they see no effort to crack down on violators trading in wild plants. Unfortunately, the propagators have not turned this resentment into pressure on responsible agencies or the Congress to improve enforcement.

At present, the statutes must continue to regulate commerce in propagated plants for several reasons. First, we do not yet have accurate information on who propagates which species. Second, CITES enforcement agencies have not yet eliminated the practice of falsely reporting wild plants to be of propagated origin. Third, enforcement officials cannot yet distinguish wild-dug from propagated plants when they inspect them at the ports. The result is that trade in plants declared to have been propagated probably continues to threaten wild populations.

It is my belief, based on several years' study of U.S. cactus imports and exports, that wild-dug plants will continue to occupy a significant share of the market until effective enforcement cuts off the supply. According to U.S. CITES Annual Reports, as recently as 1984, virtually all international trade in such slow-growing genera as Ariocarpus involved wild plants imported from Mexico and then reexported to Japan and Europe. Until 1982, this was also true of the genus Turbinicarpus despite its fairly widespread propagation. Several other countries with major propagation industries, including Japan and the Netherlands, also imported significant numbers of wild plants and may have reexported them.

Until we have much greater confidence in enforcement by all CITES parties, and by U.S. agencies for domestic species, trade regulations must continue to be applied to propagated plants.

Why do these weaknesses persist? The major reason why CITES, the Endangered Species Act, and Lacey Act have not yet lived up to their potential — or even reached the level of effectiveness with regard to fauna — is the lack of vocal public support for plant conservation. The public is largely unaware that plant species may be endangered by any cause. Those who collect or purchase succulents or other types of plants possibly taken from the wild often do not think of the connection between their actions and the health of wild populations.

One reason this situation exists is that most conservation organizations, especially the politically-active ones, have only recently begun to pay attention to the plant kingdom. Of course, The Nature Conservancy has been interested in identifying and conserving representative and unique plant species' habitats and communities since 1953. After decades of focusing on animals, especially mammals and birds, politically active conservation organizations began changing in the 1970s. NRDC was the first to establish a specific plant conservation program, in 1978. In addition to work on plant trade, it also seeks to improve protection of

plants and their habitats under other sections of the Endangered Species Act and through other mechanisms. NRDC also strives to educate the public about the importance of plant conservation.

WWF and the international TRAFFIC network have become quite active on plant conservation issues in the 1980s. Indeed, 1984-85 saw an International Plant Campaign by WWF-International and IUCN. A major focus of the campaign is public education. Another is on-the-ground conservation in areas of high endemicity, especially tropical forests and islands.

Environmental Defense Fund (EDF) expanded its wildlife program to include plants in 1982. It specializes in strengthening listing of plant species under the ESA, promoting state cooperative programs for plants, and pressuring the Forest Service and Bureau of Land Management to protect "candidate" species. EDF also persuaded Congress in 1982 to instruct the Fish and Wildlife Service to develop plant conservation programs in Latin America through the Western Hemisphere Convention.

Government agencies responsible for wildlife conservation have also been slow to incorporate the plant kingdom. Responsibility for endangered plants was thrust upon the Fish and Wildlife Service from outside. In 1982, Congress had to instruct the Administration that flora was to receive equal listing priority with fauna. Dr. Bruce MacBryde, the first scientist hired by the Service as a botanist, has been an untiring advocate of better protection, but the Service as a whole only recently became a leader in plant conservation.

The Cactus and Succulent Society of America (CSSA) and similar organizations have been divided internally. Some members have voiced their concern about endangerment of succulent plants and have urged constructive involvement. In the mid-1970s, Gary Lyons participated in an international symposium at the New York Botanical Gardens and represented the CSSA in commenting on implementing regulations for ESA and CITES, and on the California Desert Native Plants Act. Lyons tried to involve the Society in other areas, suggesting that it help the IUCN Threatened Plants Committee compile a list of endangered succulents. After a hiatus of several years, CSSA again debated over whether to ban collected plants from CSSA shows. The CSSA and its affiliates have also provided funds for some research and individual members have been active. ESA and CITES trade restrictions, which directly affect the cactus and other succulent collectors, have alienated many members and officers. They are most upset by the inclusion of all cacti, aloes, and succulent Euphorbia in CITES Appendix II and restrictions on trade in propagated plants. The CSSA commented in great detail on ESA and CITES draft regulations in 1976 and felt it obtained some changes, but remained dissatisfied on these issues.

An extremely hopeful development is the rapid growth of native plant societies throughout the country. They now exist in nearly all states. The

members are sincere and usually strong advocates for better conservation of plants and communities by all appropriate means. I expect them to make a significant difference over the long term.

In addition, a number of states have active natural areas programs that identify and conserve areas frequently chosen on the basis of plant communities or species.

Conclusion

The international and national programs adopted to conserve succulents and other plant types are not yet working well. The major reason why CITES, the Endangered Species Act, and Lacey Act have not lived up to their potential is the lack of vocal public support for plant conservation.

Government agencies now pay closer attention to plants as a result of CITES and ESA, although plant enforcement and trade-monitoring efforts lag far behind those for animals.

During the 1970s, public awareness of plant collecting as a conservation problem grew. Conservation organizations such as NRDC, WWF, TRAFFIC, IUCN, and EDF began to pay closer attention to plant conservation. Plant hobbyist groups have been involved less continuously. The CSSA was active in the mid-1970s, then became quiescent until about 1984. And, the rapid growth of native plant societies throughout the country is an extremely hopeful development.

I believe that growth in the number and strength of organizations committed to conservation of plant species promises a brighter future. These organizations already have put pressure on responsible government agencies to protect plants more actively. I believe that pressure will continue, and that the agencies will respond -- never as rapidly as we wish, but faster than before. Cacti and other succulents are among the most widely recognized plant symbols of various threats of extinction. As a consequence, they will probably benefit greatly from increased plant conservation efforts.

The key to success in the conservation arena, in my view, is increased public involvement -- learning about plant conservation issues, pressuring federal and state agencies and legislators to address them, and contributing time and money to non-governmental organizations that carry out plant conservation work. Together, we can make plant conservation a part of the mainstream of the American environmental movement.

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